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Coca Cultivation in Colombia and its Regional Economic Impact

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Management Summary

The cocaine trafficking has not changed the national sectoral composition of the Colombian economy, nonetheless has decelerated its economic growth. On the regional level, however, where coca cultivation is concentrated, further analysis is necessary. Since the previous reports focused on aggregate level data, the regional impact is still not clearly defined. Using the variable "coca cultivation hectares" and "estimated coca cultivation income" and not illicit financial flows as previous studies, facilitate to portrait the effect on regional economies.

The goal of this paper is to analyze if coca regions in Colombia show the same relationship to the illicit market as the national economy. To establish if the development of local productive economic sectors is affected by changes in the coca cultivation.

Based on previous analysis, the methodology consists of a time series from 2005 to 2016, where the economic development of coca regions is compared to other areas with no or lower coca cultivation. Then the relationship between coca cultivation and regional GDP is established through a correlation analysis. To finally measure the causality through a linear regression model using the least squares method.

The result shows that the economic development in coca regions has no particular divergence to other regions or the national economic trend. However, a low linear negative relationship is observed between coca cultivation and regional GDP, that might suggest, but no explain a deceleration of the regional economy as coca cultivation increases. The regression model, however, shows no significant results, reflecting the complexity to measure the effects illicit economies have own formal productive sectors.

The findings of this paper might not be substantial and significant to give a clear answer to how coca cultivation affects the regional economy. Nonetheless, it assists in reinforcing previous findings, in the sense that an illicit activity, such as coca cultivation serving drug trafficking, might not affect the sectoral structure of the regional economy, but show a possible decelerating effect on productive sectors.

Future researches need to be based on larger regressions models, that assist in proving more significant results. The future analysis can consider the methodology proposed in this paper, but the regression model needs to be expanded to include more variables.

At the regional level, more analysis is necessary to understand how coca cultivation affects economic development. So public policies can be directed to effectively substitute illicit activities for sustainable formal production structures that contribute to the regional economic and social development.

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1 Introduction

The latest published report from the United Office on Drugs and Crime (UNODC) states that in 2016, coca bush cultivation increased in all three coca-grower countries, Colombia, Bolivia, and Peru (UNODC, 2018b, p. 29). The coca crops covered in total in all three countries an area of 213'000 hectares (ha) (UNODC, 2018c, p. 29). This figure is remarkable, taking into consideration that in 1990, coca crops covered in the same Andean countries 211'700ha (UNODC, 2001, p. 27), a fact that might suggest eradication efforts have been ineffective. However, making a historical review of the available data, there is a notable reverse in the distribution of coca cultivation. In 1990, 73% of all coca crops were concentrated in Peru, and only 14% in Colombia (May, 2017, p. 7) Almost three decades later in 2016, 68% of coca crops were located in Colombia, and 21% in Peru (UNODC, 2018c, p. 29)

An analysis of the economic, social, and political development of these countries needs to take into consideration the drug trafficking (Thoumi, 2003a, p. 2). The drug trafficking, as defined by the UNODC, involves the cultivation, manufacture, distribution, and sale of substances prohibited by law (UNODC, 2016, p. 63), The coca cultivation, as the primary activity of cocaine trafficking, supplies a global illicit market estimated at USD 94 billion (May, 2017, p. 3) in 2014.

This paper focused on Colombia, commonly accepted since the 1980s as the leading global supplier (H. josé Gómez, 1988, p. 93). The latest report of the UNODC confirms that this old perception is still today a documented fact. In 2017 the UNODC reported the highest figure of coca crops in Colombia since 1990, 171'000 ha. This figure is even more concerning, as in 2012 and 2013 registered coca crops covered approximately 48'000 ha (UNODC, 2018c, p. 29), the lowest since 1994. This sharp increase in such a short time is followed by the fact that 75% of the coca crops in Colombia are concentrated mainly in 4 Provinces: Nariño, Putumayo, Norte de Santander, and Cauca. An Occurrence that increases and prevails since 2012 (Garzón & Llorente, 2018, p. 3).

In 2017 the Colombian National Drug Observatory (ODC) reported coca crops in 22 of 32 Colombian provinces (Observatorio de Drogas de Colombia, 2017, p. 65). Every region has its historical, socio-economic development and particular economic structures. The goal of this paper is to analyze the regional economic impact of cultivation. To answer the question: How has illegal coca cultivation impacted the Colombian economy on

a regional level? Also, to understand how, the changes in the number of coca crops could affect specific economic sectors.

Is there a negative or positive effect depending on the sector? Are other macro-economic variables, such as the unemployment rate affected by the change of coca cultivation?. Are these effects similar in every region? The paper focuses on answering these questions and assists in understanding the impact of coca cultivation on a regional level.

The economic effects of drug trafficking have been already widely under study in the Andean Countries. In Peru, studies suggest a crowding-out effect on the formal sectors of production (Concepción & Pedroni, 2011). In Bolivia, studies emphasize the role of coca cultivation as an important employment factor (de Franco & Godoy, 1992, p. 398) In Colombia studies suggest a negative impact on the economy, mainly due to the consequences the increase in corruption and violence has on the formal economy (García Ricardo Rocha, 2003, p. 299). Additionally, even positive economic effects have been suggested. One is a possible increase of the aggregated demand, a short term effect, however, surpassed by its adverse secondary effects on the long term, contraband increase and investments distortions (Steiner & Corchuelo, 1999, p. 6).

The cited studies in Colombia, however, as in Peru (Concepción & Pedroni, 2011, p. 4), tend to focus on national aggregated economic level data, on illicit financial flows and its consequences for the legal economy. The focus of this paper is a regional approach to coca cultivation and its local economic impact. This approach could help to understand the economic effects of coca cultivation on the specific coca regions. The regional focus is an advantage for implementing public policies more according to the necessities of the region and defining how public or private investments could impact the provincial GDP (Concepción & Pedroni, 2011, p. 4).

The paper structure consists of reviewing the economic impact of illicit drug trafficking in Bolivia and Peru as a relevant reference but focusing the review on Colombia. The studies review is then complemented with important context information concerning coca cultivation in Colombia, its historical development, and its measurement on the national GDP. After this, the paper will then present in a general sense the economic development, 2005 to 2016, of Colombia. This theoretical framework and context information leads to the data analysis on a regional level of eight provinces in Colombia with coca crops on their territory. The methodology consists of a correlation analysis to measure the

relationship between the coca cultivation and regional sectorial GDPs, in cross-sectional regional data, 2005 and 2016. Additionally, the regression analysis, 2005 to 2016, using the least square method (Anderson, 2009, p. 498) assist in calculating the possible cause or effect between the coca cultivation and regional GDP. The results will be then presented and discussed, to finally, postulated the conclusions of the analyzed data.

This paper focuses centrally on the economic impact of coca cultivation in Colombian coca regions. It is essential to signal that illegal drug trafficking has a significant cultural, economic, environmental, moral, and social impact on all levels of society (Thoumi, 2003b, p. 20). However, analysis or assessment out of an economic focus exceeds the study approach of this paper. Non-economics impacts are considered, as inevitable bound consequences of drug trafficking, but these will only be referred in a general way.

2 Background and Literature Review

The following chapter will review the main findings concerning the economic impact of drug trafficking in Bolivia, Peru, and Colombia. It will review the main findings in Bolivia and Peru, to then present a more extensive review concerning previous studies findings for Colombia. However, first, as an essential context and ground information, the market structure of the global cocaine market is presented.

2.1 Global cocaine market size and structure

The following subchapter has the objective to explain in a general sense the structure and financial flows of the global cocaine market. Indented to give an understanding of the role and size of the coca cultivation along the global cocaine supply chain.

The UNODC estimated in 2008 that the global cocaine market value ranged from 88 to 100 billion USD, equivalent to 0.15% of the global GDP (UNODC, 2012, p. 56) The European and North America market represented in 2010, approximately 80% of the worldwide Market (UNODC, 2010, p. 71). A recent study published by the non-profit organization Global Financial Integrity (GFI) estimated the value market in 2017 in the range of USD 94 to USD 143 billion (May, 2017, p. 3).

As a historical review, the international drug trafficking with cocaine was first reported beginning the 1970s and started increasing significantly in the 1980s (Thoumi, 2003b, p. 84). The highest level ever reported area of cultivation was reported in 1990 with 288'400ha (ODCCP, 1999, p. 41) although the current market is estimated to be smaller than in the 1990s when is value was estimated to be 165 billion USD (equivalent to 2008 prices) (UNODC, 2010, p. 69).

The structure and the supply chain can be described concisely in the following five activities (Bergman, 2015, Chapter 3.2).

2.1.1 Coca leaf cultivation

Generally performed by farmers, with no affiliation to any central organization and in small portions of land, (Bergman, 2015, p. 31) known popularly as "Cocaleros" (Thoumi, 2003a, p. 129),. The "Cocaleros" harvests the leaves from the coca bushes; the coca leaves. After the harvest, the leaves are processed into coca-paste, by the same farmers or sold to the collectors or processors, known as "Traqueteros" (Thoumi, 2003a, p. 129). The "Traqueteros" then process the coca leaves into coca paste or cocaine base. The cost

of cultivation tends to be very low, but also with low-profit margins (Bergman, 2015, p. 31)). The market value of coca leaf cultivation was estimated (2011) at USD 600 million (Organization of American States OAS, 2013, p. 23).

2.1.2 Cocaine production

The processing of coca leaves into coca paste can be made through a relatively simple chemical process, not requiring major equipment or inputs materials (UNODC, 2016, p. 25). However, the process to manufacture cocaine base and then cocaine hydrochloride (pure cocaine) requires a laboratory with the capacity to process large quantities of coca paste (Bergman, 2015, p. 32). The process requires a productive network that includes lab assistants, security, and logistics personnel (Thoumi, 2003a, p. 129). Therefore, laboratories tend to be organized or being under the control of a central crime organization (Bergman, 2015, p. 32) The market value for the production of cocaine and its derivates was estimated at USD 3 billion (Organization of American States OAS, 2013, p. 22).

2.1.3 Transit (Trafficking)

The trafficker transports the cocaine to the wholesalers, or directly to the retailers, in consumer or transit countries (Bergman, 2015, p. 32) The transit phase, drug smuggling, is the most intensive labor and costly operation on the supply chain (Bergman, 2015, p. 32) It requires a considerable workforce, materials, infrastructure, and equipment. Because of this, the transit phase is dominated by well-organized drug traffic organizations with the capability to finance and conduct such large operations (Bergman, 2015, p. 32) The market value of cocaine transit, cocaine smuggling, is estimated at USD 8 billion (Organization of American States OAS, 2013, p. 22). Most relevant transit countries are Brazil, Mexico, Nigeria, South Africa, Spain, and the Netherlands (UNODC, 2018c, p. 34).

2.1.4 Wholesales

The wholesalers, mainly controlled by drug traffic organizations, distribute the shipments from the traffickers to the retailers within the consuming market. Estimated market value, 22 billion USD (Organization of American States OAS, 2013, p. 22).

2.1.5 Retail sales

The cocaine sales to the final customer have the highest profit margins on all the supply chain. In this phase there are nearly no production or transit cost (Organization of

American States OAS, 2013, p. 22) Almost 80% of all retail sells take place in North America and Europe (UNODC, 2012, p. 79) In these markets, the retail price tends to be four times higher than the ones in transit countries, and even 50 times higher than in the coca-grower countries (Bergman, 2015, p. 33). The global value of retail sales was estimated to be 55 billion USD (UNODC, 2012, p. 79).

However, the market share of the Andean farmers in Bolivia, Colombia, and Peru is estimated at only USD 500 million (Organization of American States OAS, 2013, p. 22).

2.2 Coca cultivation and its economic impact in Bolivia.

The national government of Bolivia and the UNODC started in 2001 a cooperation to monitored the coca crops in the county. The first report published in 2003 indicates coca crops covered an area of 23'600ha (as seen in Figure 1) with an estimated market value of USD 210 million, representing 2.7% of the national GDP. (UNODC, 2005, p. 4). The most recent report, 2017, states that coca crops covered an area of 24'500ha with an estimated market value of 374 million USD, representing 0.8% of the national GDP. (UNODC, 2018a, p. 1).

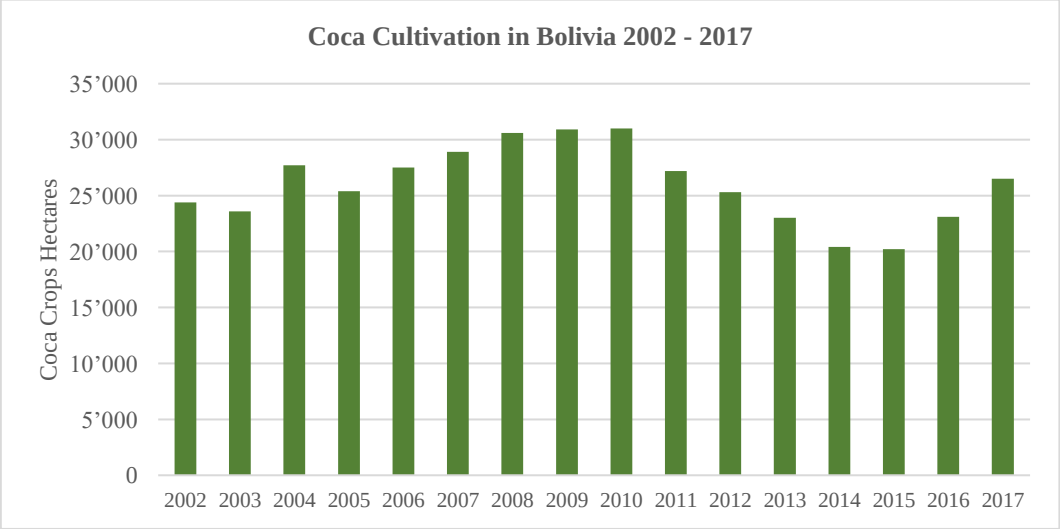

Table 1: Coca cultivation in Bolivia (Source UNODC)

The analysis of the economic impact in Bolivia is mostly concentrated on the agricultural sector. De Franco and Godoy (1992), estimated that an increase of 10% in cocaine production raises the GDP by 2% and lowers the unemployment by 6% (de Franco & Godoy,

1992, p. 390). The relationship is explained; As coca cultivation increases and therefore cocaine production, more workforce needs to be employed, having a positive effect on the demand, mainly for agricultural products (de Franco & Godoy, 1992, p. 393)

The effect is related to the large workforce involved in the coca cultivation; in 1990, it was estimated to represent 10% of the economically active population (Painter, 1994, p. 41).

On the regional level, in the coca region of la Cochabamba. During the 1980s, the economic development growth, especially in the construction sector, was notably higher than the national average, and it is suggested this is due to investments of trafficking organizations that focus on the real state investments as a way to legalize their profits (Painter, 1994, p. 56). Nevertheless, other industry sectors reported no significant economic growth, and the illicit funds circulating in the economy with no productive investments are suggested to be the cause for the higher inflation rate reported in Cochabamba during the early 1980s (Painter, 1994, p. 57).

The findings of De Franco and Godoy (1992) suggest a positive relationship between the coca cultivation, national GDP, and employment. However, this positive effect is only suggested in the short term (de Franco & Godoy, 1992, p. 398). On the long term, the lack of investments in more productive sectors other than construction, and the possible effects on the exchange-rate from drug trafficking flows reduce the competitiveness of the national productive industry (de Franco & Godoy, 1992, p. 398).

On the regional level, however, coca cultivation is suggested to be an essential factor for socio-economic stability in regions where coca cultivation is historically concentrated, as other formal economic activities opportunities remain low (Rojas, 2002, p. 26). More recent researches show that coca farmers in Bolivia tend to have a lower poverty incidence in comparison to other agricultural activities (del Carmen Choque & Jemio, 2006, p. 23).

The forced eradication of coca crops, without well-structured alternative development programs in past decades, especially during the late 1990s, affected thousands of coca farmer families, increased poverty and fostered rural migration (del Carmen Choque & Jemio, 2006, p. 12). In Bolivia, the eradication of coca crops is suggested to be counterproductive, as they harm more the coca farmers than benefiting them (Grisaffi & Ledebur, 2016, p. 7).

This general review of the impact in Bolivia reflects the complexity of the topic. Drug trafficking might benefit the national economy in the short term, as suggested by De Franco and Godoy (1992), but the benefit is surpassed by the adverse effects on the long term. However, focusing on coca cultivation, the primary activity of drug trafficking, it is challenging to draw an up to a final balance for Bolivia. The small income from coca farming is known to have no impact on the national economy, but on the regional economy, it is expected that coca farmers deposit surpluses in short-term saving companies, small land and house properties (Painter, 1994, p. 57). Even so that rural areas in Bolivia, seemed to be more prospered than urban regions, as coca cultivation and cocaine production increased (Léons, 1993, p. 135).

It is also important to state, that the Bolivian economy has been historically smaller, with a higher dependency on the agricultural sector than the other reviewed countries, Colombia and Peru. Most recent data available from the Economic Commission for Latin America and the Caribbean (CEPAL) reflects this persistent economic difference. The GDP in 2017 reported by the CEPAL was for Colombia USD 313.9 billion, and agriculture production represented 7.6% of the total economy. For Peru a GDP of USD 211.2 billion, from which agriculture also represents 7.6%. Finally, for Bolivia, a GDP of USD 37.5 billion, and an agriculture sector that represents 13.4% of the economy (CEPALSTAT, 2019)

2.3 Coca production and its economic impact in Peru

Until the middle 1990s, Peru was by far the largest coca-grower country; Covering during the 1980s, 70% to 75% of the world supply of coca leaves (UNODC, 2002, p. 5). The production was mainly smuggled to Colombia, where criminal organization controlled cocaine trafficking into the United States (Thoumi, 2003b, p. 44). In 1990, coca crops in Peru were estimated to cover 210'100ha, and in Colombia "only" 40'100ha, the rest were located in Bolivia (ODCCP, 1999, p. 42). Since the adoption in Peru of the "National Drug Prevention and Control Plan," the country has reduced significantly its area covered with illicit crops (UNODC, 2002, p. 5). Causing, among others, the displacement of coca crops to Colombia (Thoumi, 2003b, p. 45).

Since 1998, the UNODC and Peru started the national coca monitoring system, making the reported and registered data more reliable. In the long-sighted view, coca crop crops

have remained relatively stable (UNODC, 2017, p. 9), despite a continuous increase registered from 2006 to 2012 (as seen in Figure 2).

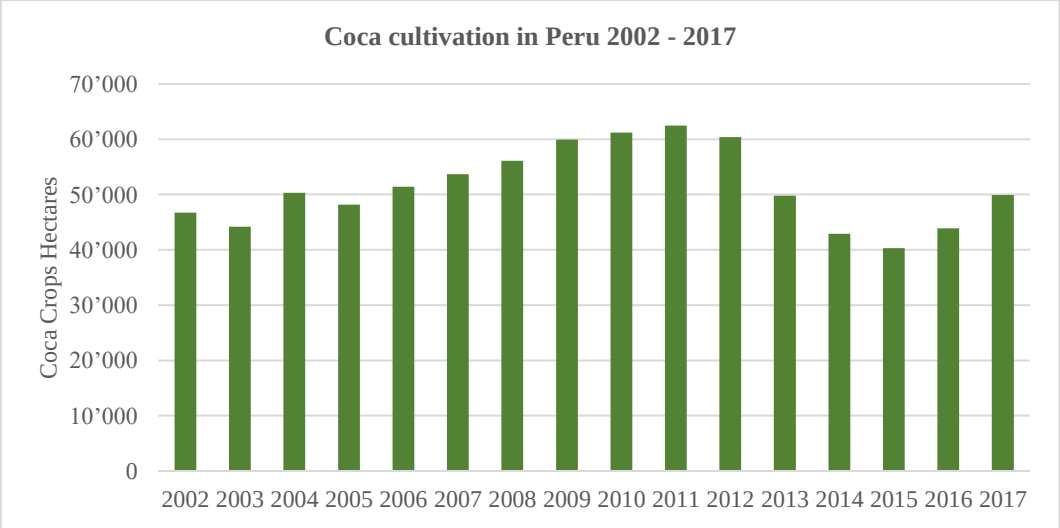

Table 2: Coca Cultivation in Peru 2002 – 2017 (Source UODC)

The market value for coca cultivation in 2003 was estimated at USD 304 million, and the most recent report (2017), estimated the value at USD 399 million. Representing respectively 0.44% and 0.18% of the national GDP (UNODC, 2017, p. 7). In Peru, since 1978, the own state company ENACO S.A. owns the monopoly on the commercialization and industrialization of coca leaves for licit and authorized uses (ENACO S.A., 2017, p. 9). However, only 1.5% of the coca leaf production is estimated to be processed by the ENACO S.A., having annual revenues of approximately USD 10 million (ENACO S.A., 2017, p. 19) Meaning, that almost only 10% of the coca crops are related to traditional use in authorized zones, and the remaining 90% is linked to drug trafficking (ENACO S.A., 2017, p. 19).

In Peru, as described in Bolivia, the coca cultivation has been a significant income substitute and employment factor for rural workers living in remote areas with low access to formal productive activities (Shams, 1992, p. 141). During the early 1990s, jobs related, directly or indirectly, to the coca cultivation and cocaine production were estimated in 800'000, and the repatriated illicit funds were estimated to represent 5.2% of the national GDP (USD 800 million) (Shams, 1992, p. 140).

In a general sense, the primary effect on the short term is the same as described in Bolivia, a positive impact on the demand for consumables products, as more workers get involved in cocaine trafficking (Shams, 1992, p. 140).

Concepción and Pedroni (2011) analyzed the relationship between cocaine production and formal economic activity in Peru. They concluded that coca production tends to crow out formal production sectors at the regional level but without a significant impact on the total national production (Concepción & Pedroni, 2011, p. 18). Mainly due to the spill-over effects of the illegal coca industry on legal informal and formal economy (Concepción & Pedroni, 2011, p. 19). For example, in its VAR- Model (Vector autoregression Model), Concepción and Pedroni (2011) estimated that in the coca region of Ayacucho, an increase by 42% of the coca production, only decrease the regional GDP by 0.0025%, meaning that coca production crowds out formal economy, but including illegal and formal production, the GDP still increases (Concepción & Pedroni, 2011, p. 14). The working paper also considered the opposite relationship, meaning that shocks to the regional GDP by 3% can lead to an increase of coca production by 20% (Pedroni & Verdugo Yepes, 2011, p. 14).

However, the working paper also indicates difficulty to record illegal activities on a national and local level, resulting in estimations based in assumptions that limit the results of the estimations (Concepción & Pedroni, 2011, p. 17).

Focusing on the agriculture sector, a study published in 2009 by the Institute for International Studies of the Pontifical Catholic University of Peru, *"The Drug Trafficking Map of Peru,"* signaled a negative relationship between illicit coca crops and agricultural production (Novak, Namihas, & Garcia, 2009, p. 395). In the regions, Ayacucho and Huánuco were coca crops regularly increased from 2001 to 2007, by 33% and respectively 47%, the formal agricultural production decreased by 6.13% and respectively 4.64%. In comparison, the region of San Martin, where coca crops decreased by 85%, the agricultural production increased by 3.55%. (Novak, Namihas, and Garcia 2009:396).

The review on Peru and Bolivia, suggest that coca cultivation seems only to benefit, in an economic sense, rural workers in the coca regions, as employment and income source. However, on the national level, the impact has been negative or not significant. Meaning as Thoumi (2003) suggests, coca cultivation is a central funding source for rural workers, but the income is not large enough so that coca cultivation could incite a stable and long-term socio-economic development (Thoumi, 2003a, p. 260).

2.3.1 Bolivia, Peru, and Colombia, what is different?

Before reviewing the main findings for Colombia, it is relevant to postulate the question regarding drug trafficking, where lies the main difference in these countries regarding drug trafficking?

The drug trafficking in Colombia has had much more societal adverse effects than in any other Andean country. Colombia experienced a severe increase in violence and crime not seen in Bolivia or Peru (Thoumi, 2003a, p. 232).

There are many variables, historical events, and national singularities that can assist in explaining this development. In a general sense, and also following the economic focus of this paper, two critical factors are essential.

- First: The criminal organization in Colombia, unlike Bolivia and Peru, started in the cocaine market principally as traffickers, not growers or producers. Only after the middle 1990s, coca cultivation started to increase significantly in Colombia, meaning, Colombian criminal organizations focused its illicit activities in the more adding value activities of the supply chain (Thoumi, 2003a, p. 259).
- Second: The Colombian criminal organization seemed to have a comparative advantage to other countries, due to the lowest-risk of being detected by authorities, as Colombian regions suitable for coca cultivation tend to be isolated and have low state intervention (Thoumi, 2003b, p. 44).

2.4 Coca cultivation and its economic impact in Colombia

This chapter will review the central studies findings concerning the economic impact of coca cultivation and drug trafficking in Colombia. A short historical review of the recent development of coca cultivation as presented in Bolivia and Peru is excluded for this part. As a more deeply historical review of the coca cultivation in Colombia is presented in the next chapter.

Considering that the Colombian role on the cocaine market was primarily trafficking until the 1990s, it is important to review the impact of repatriated illicit financial flows on the Colombian economy regarding the exchange rate. These findings might be not relevant for the analysis proposed in this paper but reflects the size cocaine trafficking has reached on the national economy.

Steiner (1997) estimated the "excessive" private transfer remittances between 1985 and 1994, explained; As the difference between projected remittances (expected amount of transfers based on Colombian emigration) and the real reported transfers (Steiner, 1997, p. 60). Concluding that, the projected transfers should have represented 0.75% of the national GDP, but the real transfers represented 2.4% to 3.2% of the national GDP (Steiner, 1997, p. 61). Steiner (1997), concluded that the average annual excess of USD 800 million is possible caused primarily by cocaine trafficking (Steiner, 1997, p. 68).

This excess of transfers is suggested to have caused an appreciation of the real exchange rate, constraining the development of export sectors such as agriculture and the manufacturing industry, and benefit the service and construction sectors. (Steiner & Corchuelo, 1999, p. 13)

Most recent studies have suggested, however, a low relationship between the exchange rate and drug trafficking. The increase in the exports of traditional goods such as café and oil in the 1990s are suggested to have a much higher effect than drug trafficking (García Ricardo Rocha, 2003, p. 291)

The focus of this paper is the analysis of local productive sectors and coca cultivation. However, most studies are based on the impact of drug trafficking. The definition "drug trafficking" includes all the activities on the supply chain (UNODC, 2016, p. 63). However, the impact is expected to be similar, taking only into consideration coca cultivation.

2.4.1 Agriculture

Same as cited in Bolivia and Peru, in the short term, the revenues from drug trafficking will increase the intern demand for consumable goods (Steiner & Corchuelo, 1999, p. 7). On a regional level, previous analysis state that in regions with illicit crops Caqueta and Vichada, rural workers had an estimated higher income by 41% and respectively 36% than the national average (H. josé Gómez, 1988, p. 105). However, on the long term, an increase in agriculture production is not observed, as it is assumed, the production fails to cover the demand increase, causing local inflation for agricultural products (H. josé Gómez, 1988, p. 105).

Most recent data estimated the net annual income for family farmers involved in coca cultivation at USD 5194 in 2006, and for family farmers not involved in coca cultivation at USD 2413 (Dávalos, Bejarano, & Correa, 2019, p. 382). However, the circumstances

seem to prevail in the regions where coca is cultivated, as the income is suggested to serve primarily to avoid poverty, but has no impact on increasing the agricultural production in the long term (R. G. Rocha, 2011, p. 52).

The central impact on the agriculture sector related to drug trafficking is the concentration of rural land by criminal organizations. (García Ricardo Rocha, 2003, p. 299). A situation that also sill prevails today affecting the development of the agricultural sector negatively, as investments in the rural sector from drug money tend to be related to less productive activities such as livestock production (R. G. Rocha, 2011, p. 125).

2.4.2 Construction

The majority of previous findings related to the construction. The impact, however, is primarily centered in urban areas (Rocha García, 2011, p. 102). To date 2010, the reported value of all seizure properties in Colombia related to drug trafficking was estimated at USD 1.8 billion, from which 91% were urban properties and only 9% rural (R. G. Rocha, 2011, p. 102).,

Therefore most analyses have also center in urban areas, especially in Medellin, the center of the drug trafficking during the late 1980s. The data comparison between Medellin and Barranquilla, a similar city at the time but no significant influence of drug tracking, showed that between 1973 and 1987 the increase in building permits in Medellin was 178%, but in Barranquilla decreased by 37% (H. josé Gómez, 1988, p. 108).

The relationship between drug trafficking and the construction sector, however, is not clear. As positive development in specific urban areas tend to be more related to developments in the formal economy (Steiner & Corchuelo, 1999, p. 12). Also, Rocha (2000) sustain this conclusion, illicit funds are indeed investing in the construction sector, but its impact is not significant, as increases of repatriated illicit financial flows are not observed to correlate with the development of the construction sector (Garcia Ricardo Rocha, 2000, p. 139)

2.4.3 Commerce and Services

The previous analysis of the commerce and service sector suggest a low negative relationship (Garcia Ricardo Rocha, 2000, p. 140). The relationship is explained due to the increase in contraband; the local commerce cannot compete with the lower prices and suffers profit loses (Garcia Ricardo Rocha, 2000, p. 140).

Although the money generated in the cocaine industry tends to avoid the formal financial sectors in order reduce reporting risk, soon or later a significant amount is suggested to be deposit in bank accounts (H. josé Gómez, 1988, p. 107). Nevertheless, according to more recent findings, drug traffickers used primarily contraband to launder its profits (R. G. Rocha, 2011, p. 94). Recent estimations suggest that from 2000 to 2009, annual private capital flows in the Colombian financial sector, related to cocaine trafficking, rounded the USD 98 million (R. G. Rocha, 2011, p. 97).

2.4.4 Coca cultivation and employment

In 1998, it was estimated that coca cultivation employed 9% of the national rural workforce, and drug trafficking-related activities involved 3% of the total economically active population, around 300'000 people (Steiner & Corchuelo, 1999, p. 14). In provinces with a high level of coca crops, Caqueta and Putumayo, this figure was even higher, representing 36% and respectively 57% of all rural employment (Garcia Ricardo Rocha, 2000, p. 141).

Most recent literature states that from 1999 to 2008, the coca crops demanded annually on average 103'000 jobs, representing 2.1% of the national rural workforce (R. G. Rocha, 2011, p. 83).

The positive relationship between coca cultivation and employment is suggested principally for rural workers. However, as contraband increases, primarily labor-intensive and non-specialized industries are affected, principally the appliance and textile industry. As a consequence, these industries suffer sale loses and lower their production, hurting the employment opportunity of unskilled workers (Steiner & Corchuelo, 1999, p. 11).

2.4.5 Main conclusions for Colombia

As conclusion, Rocha (2003), having study widely the economic and social effect of drug trafficking, suggest that in overall, drug trafficking might not have affected the national macroeconomic composition, but at the regional level the socio-economic consequences are significant, mainly due to the concentration of rural land by criminal organization (García Ricardo Rocha, 2003, p. 299). Moreover, that, the coca cultivation has affected the agriculture sector in border regions (primarily as employment factor), as illicit financial flows tend to be invested in urban centers (García Ricardo Rocha, 2003, p. 292).

An actualized review on the impact of drug trafficking; however, sustains that drug trafficking has not affected the economic structure as a whole, but has caused a deceleration of the formal economic growth, displacing the formal productive sectors at the national level, as illicit funds tend to be invested in low productive sectors (R. G. Rocha, 2011, p. 125). However, most importantly, considering the intangible cost due to a severe increase in crime, corruption, and violence, the cocaine trafficking has severely affected the economic and social development in Colombia (Steiner & Corchuelo, 1999, p. 19).

As a merely visual description (as seen in Figure 3), the negative relationship on the national economy, deceleration of formal economic growth, is suggested to be visible as coca cultivation increased significantly during the 1990s (R. G. Rocha, 2011, p. 126).

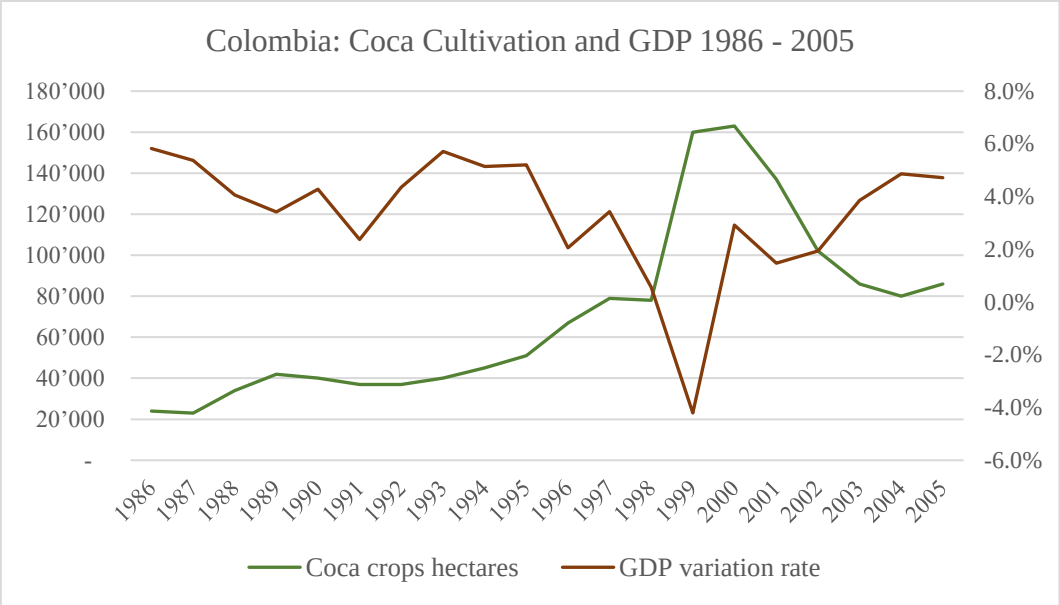

Table 3: Colombia: Coca Cultivation and GDP 1986 – 2005 (Source DANE)

Taking into consideration these stated conclusions, is necessary to pose the question: What and how can this paper contribute to previous analysis?

The answers relay in the approach of this paper. Previous studies tend to focus its analysis on the repatriated illicit financial flows, including all activities of the supply chain and national economic aggregated data (Concepción & Pedroni, 2011, p. 4). The motivation of this paper is, however, to perform a regional analysis based on coca cultivation, a variable much suitable for regional analysis, an analysis that assists in establishing clarity

about the relationship between the coca cultivation and regional GDP, and its different economic sectors.

These paper bases its analysis on previous procedures that are accorded to the complexity limit of this paper, for example, a simple comparison of the economic growth between a region with coca and one with no coca cultivation (H. josé Gómez, 1988, p. 104). To observe any particular pattern. To then made a more suitable analysis to measure the relationship between the two variables, coca cultivation and regional GDP, this will be explained more furtherly on in the chapter; 4. Methodology.

The next chapter will present and give clarity about the historical development of coca cultivation in Colombia and its size on the national economy. Important context information to understand the size and economic factors related to coca cultivation in Colombia.

3 Coca cultivation in Colombia:

The development of the coca cultivation in Colombia is deeply related to the development of violence and crime(Thoumi, 2003b, p. 181). Since the 1960s different criminal organizations have emerged in the country, starting with the Marxist guerrillas FARC-EP (Revolutionary Armed Forces of Colombia-People's Army) and the ELN (National Liberation Army) among others during the 1960s. The drug cartels in Cali and Medellin founded in the middle and late 1970s, achieved to control the global cocaine market until the early 1990s (Thoumi, 2003b, p. 195). After the cartels disappear in the middle 1990s, the control over the coca cultivation and cocaine trafficking was taken by paramilitaries groups. All these developments have a common denominator and financing source, the cultivation of illicit crops, coca, and marihuana (Molano, 2004).

3.1 Historical review of the coca cultivation in Colombia

In a few highland areas of Colombia, coca cultivation for traditional uses has existed since centuries, and its represent an essential part of the cultural and ethnic identity of diverse indigenous groups (Thoumi, 2003b, p. 79). The coca cultivation, serving intentionally as raw material for the illicit drug trafficking, is suggested to appear at the beginning of the 1970s (Thoumi, 2003b, p. 82).

The "war on drugs" incited in 1971 by the government of the United States, motivated the Colombian government to take action against the existing marijuana crops, estimated at the time to cover 30'000ha (Thoumi 2003:87). The eradication policy centered in areal fumigation had an ambiguous success, as marijuana crops were reduced significantly, but coca crops started to increase. The experience with marijuana trafficking is one the reason why cocaine trafficking in developed in Colombia. (Melo, 1998, p. 68)

As coca cultivation started to increases significantly in the 1980s, mainly in Peru, in order to satisfy the increasing demand (Thoumi, 2003b, p. 260). The coca paste or cocaine was smuggled into Colombia., and from there trafficked into the United States. The role of Colombia during the 1980s on the supply chain consisted primarily in trafficking, and not cultivation (Melo, 1998, p. 69).

The economic development is also suggested to have played a significant role leading to the increase of coca cultivation and cocaine trafficking (Molano, 2004). From 1975 to 1978, the Colombian economy experienced a significant positive economic growth (As

seen in Figure 4). This positive development is related to the favorable international market conditions for Café, at the time, the main Colombian commodity (Kalmanovitz, 2004, p. 108). In the 1980s, the economic growth started to decelerate, as other countries in Latin America went into an economic crisis, Colombia managed to maintain a lower but stable economy growth (Kalmanovitz, 2004, p. 99). It is suggested, that the constraint of the formal economy and principally the decrease of international café prices have contributed to the increase of cocaine trafficking, as an alternative income source (Molano, 2004).

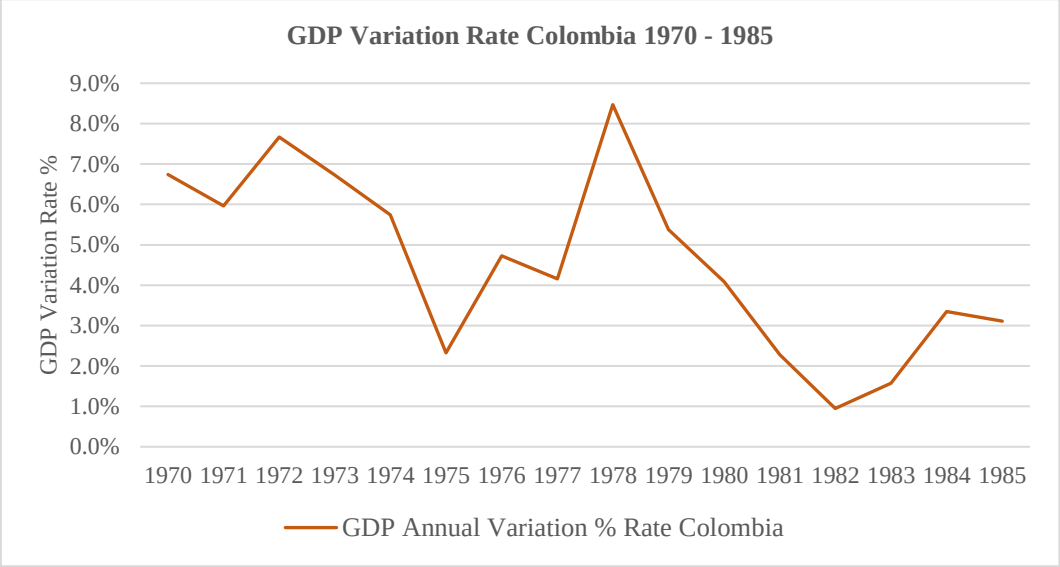

Table 4: GDP Variation Rate Colombia 1970 – 1985 (Source DANE)

As violence related to cocaine trafficking began to increase in the middle 1980s, not only in Colombia but also in the United States (primarily due to power disputes among criminal organizations), the "drug on war" was consequently directed on cocaine (Thoumi, 2003b, p. 328).

The increasing disputes from state forces against drug cartels lead to a severe increase in crime and violence in Colombia (Melo, 1998, p. 72). As the cartels dissolved in the early 1990s, guerrillas and paramilitaries groups began to control the coca regions, and get involved in the cocaine trafficking to finance its operations (Melo, 1998, p. 80). (As seen in figure 5)

By 1998, Colombia already became the largest coca and cocaine supplier, displacing the coca cultivation in Peru (Thoumi, 2003a, p. 85). Historical researches state two main reasons for the displacement. One is the already stated aggravation of the armed conflict in

Colombia during the 1990s, as criminal organizations foster coca cultivation to fund its operations (Molano, 2004).

Second, the more effective eradication and mitigation policies implemented in Peru (Díaz & Rivera, 2010, p. 5). The displacement is explained as a "balloon effect." As public policies are implemented to mitigate illicit activities in one country, the illicit markets adapt and change their operations according to the new system. Therefore cultivation is displaced to a most attractive and profitable location. (Raffo López, Castro, & Díaz España, 2016, p. 211).

In 1999, through the implementation of the Plan Colombia, coca crops eradication started to report consistent results The Plan Colombia consists of financial and military, aid to Colombia, to support, among others, the mitigation of coca cultivation and cocaine trafficking (Thoumi, 2003b, p. 230). The Plan Colombia has been criticized, as it centers its eradication policy on areal spaying with herbicides, but tends to overlook alternative development programs to substitute illicit crops. (Mejia & Posada, 2008, p. 34).

The strategic approach of the Plan Colombia has been widely discussed and criticized. As critics signals, the Plan Colombia focusses in a constant and intense aerial fumigation of coca crops, without any social development policies, not resolving the causes that conduce to coca cultivation (Guevara Latorre, 2015, p. 82). Also, studies analyzed the cost-effectiveness of the Plan Colombia, suggesting that the aim on reducing coca cultivation is ineffective, as a three-fold increase of the Plan Colombia budget, annual budget being about USD 1 billion, would only decrease the cocaine trafficking supply by 17% (Mejia & Restrepo, 2009, p. 44).

The severe increase between 2013 and 2017 accounts intern political decisions and extern economic influences. The economic causes that lead to an increase to the coca cultivation are suggested to be caused by the revaluation of the US-Dollar, and the drop in the international gold price (Ávila, 2019). This development affects the profitability of other illicit activities such as illegal mining, making cocaine trafficking more profitable for criminal organizations (Ávila, 2019).

Complementary, significant political events are also related to the increase. First, the suspension of areal fumigation with glyphosate in 2015 by then-President Juan Manuel Santos (2010 – 2018), arguing risks for the environment and human health (Gaviria, 2015). Second, the signing of the peace agreement with the FARC-EP in 2016. The territories

controlled by these guerrilla group began to fall into the control of other criminal organization, destabilizing the existing cocaine market leading to a fostering of coca cultivation and (Garzón & Llorente, 2018, p. 4).

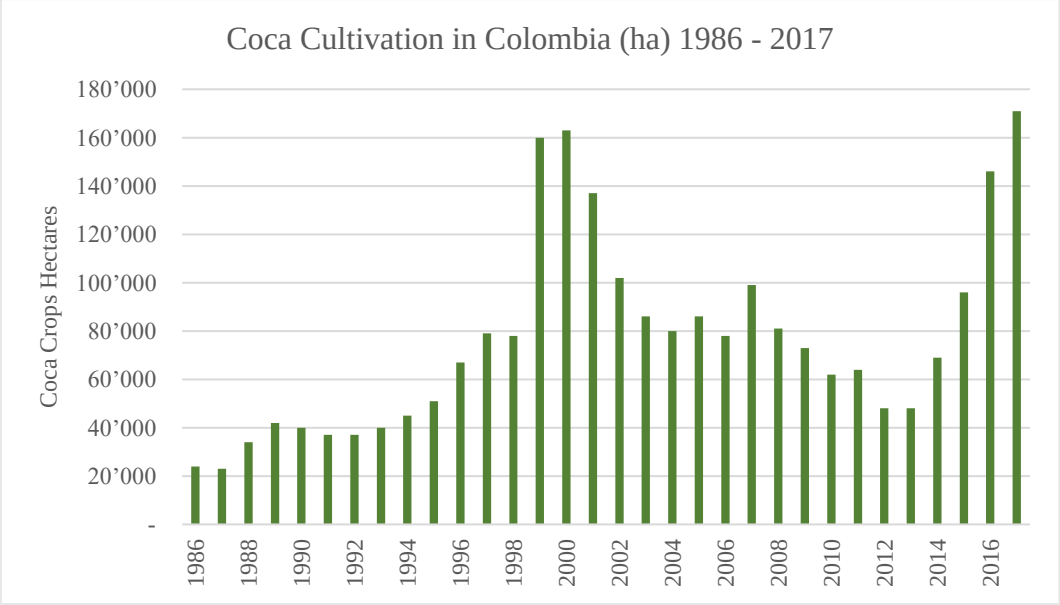

Table 5: Coca Cultivation in Colombia (ha) 1986 – 2017 (Source DANE)

3.1.1 Why coca cultivation persists in Colombia?

As described above, since the middle 1980s Colombia reports areas with coca cultivation and the most recent report state that cultivation is today more extensive than 20 years ago (UNODC, 2018c, p. 29). The questions, why coca cultivation persists in Colombia, and why the country has reported in the past years a much higher increase compared to other Andean countries, is not a focus of this paper. The answer to such questions implies a more in-depth analysis of economic, social, and political aspects. However, as this paper intends to analyze the regional economic impact of the coca cultivation, it is crucial to state, that historically coca cultivation has been concentrated in the poorest and marginalized zones of the country. Areas where public investments and services, private funding sources, and infrastructure tends to be absent (R. G. Rocha, 2011, p. 51). For the population in these areas, coca cultivation represents a basic income and sustenance source, as the formal economy and state aid are scarce. The state abandonees of the regions have also facilitated the presence of armed groups, increasing even more coca cultivation. A vicious circle that has been enduring for decades (R. G. Rocha, 2011, p. 47).

The "balloon effect" also explains why coca cultivation persists in Colombia. In Colombia, the effectiveness rate of eradication or substitution policies varies from region to region (Garcia Ricardo Rocha, 2007, p. 15). Areal fumigation might have positive results in one region, but it might increase the spread rate of coca cultivation in other regions, resulting in a total net increase of coca cultivation (Garcia Ricardo Rocha, 2007, p. 17). Mitigation policies tend to ignore local conditions; the data shows that national eradication strategies are ineffective, and a more regional and local approach is necessary (Garcia Ricardo Rocha, 2007, p. 24).

The, figure 6, shows, the suggested "balloon effect," as in some areas coca cultivation increase, but in others, the increase was higher. The figure also shows how coca cultivation is a chronical problem in specific regions of Colombia[1].

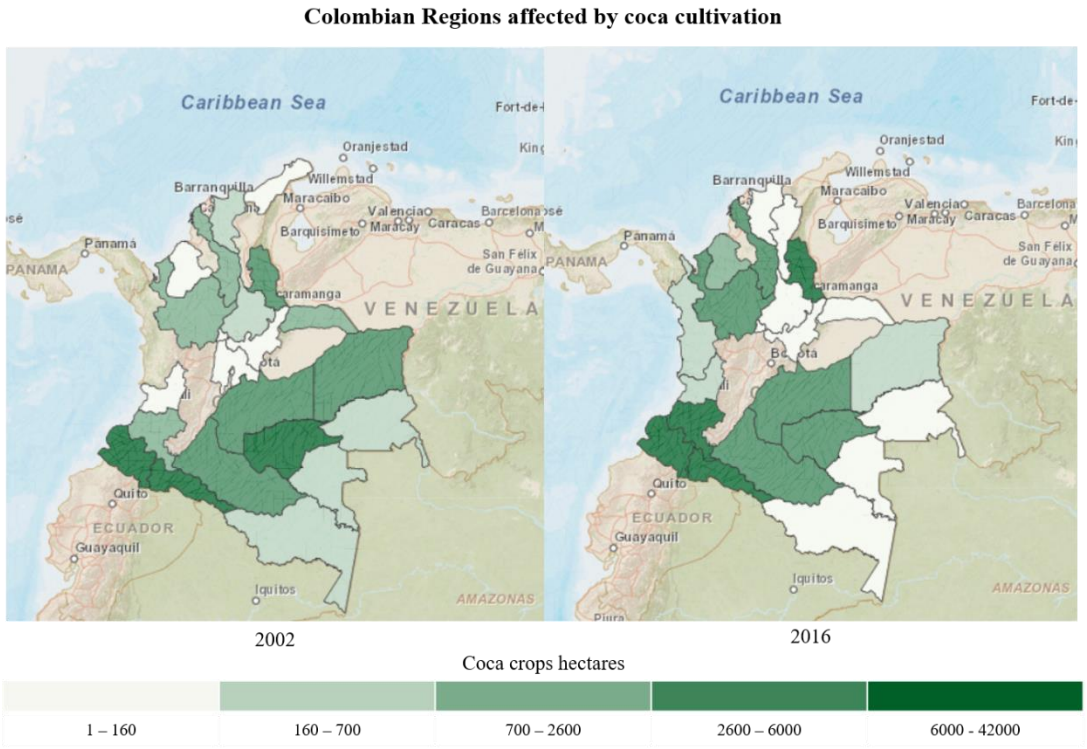

Table 6: Colombian Regions affected by coca cultivation (Source SIMCI)

[1] See Appendix A

3.2 Coca cultivation and national GDP

Different studies in Colombia have estimated the size of the drug trafficking relative to the national GDP. This figure is usually used as a base for any analysis. Due to the nature of illicit markets, the estimations are difficult and complex and require to be calculated under assumptions that might not reflect the true size of the market (Thoumi, 2005, p. 186).

The first known academic based figure published in Colombia was estimated by Junguito and Cabellero (1978). The results exposed, estimated that cocaine production represented 0.9% of the national GDP in 1978, approximate USD 140 million, from which coca cultivation (almost inexistent at that time in Colombia) only represent 1%, the most significant part represented trafficking and wholesales (Junguito & Caballero, 1978, p. 122).

Since the 1980s, due to the increase of drug trafficking in Colombia, many estimations were published regularly, principally Steiner (1998) and Rocha (2000) have reviewed estimations from 1980s to 1998s, and also published their proper calculations.

The following (table 1) shows the reviewed average estimations of drug trafficking relative to the national GDP.

Review estimations of the drug trafficking income relative to the national GDP in Colombia				
Time Period	1981 – 1985	1986 - 1990	1991 - 1995	1996 - 1998
Average	2.9%	5.1%	3.9%	2.2%
USD billion*	0.52	1.12	1.05	0.67

Table 7: Review estimations drug trafficking relative to the national GDP

The table reflects the development described in the previous chapter. As the middle 1980s, were cocaine cartels expand its operations massively, the drug trafficking had a considerable weight on the formal economy. However, as cartels disappeared, and the role of Colombia on the supply chain started to direct into primary coca cultivation, the weight on the formal economy has been declining.

3.2.1 Coca cultivation and illicit financial flows

The estimations above are based on repatriated illicit financial flows, a variable that tends to focus on cross-border transactions (Aziani, 2018, p. 1). Such estimations calculated for illicit economies, are helpful to asses the dimension of the criminal activities and assist in designing the distribution profits along the supply chain (Aziani, 2018, p. 105).

However, as the focus of this paper, relays on a regional economic impact analysis, referring to estimations based on illicit financial flows, certainly assist in describing the size of the illicit market, but might not be adequate to represent the size coca cultivation accurately in proportions of the formal economy.

Fortunately, since 2000 the National Department of Statistic in Colombia (DANE), in conjoint work with the UNODC and ODC published an estimated aggregated value of all productive activities, legal and illegal, associated to coca cultivation within the national territory. The external sales in other countries, meaning cross-border transactions are excluded (DANE, 2011, p. 7).

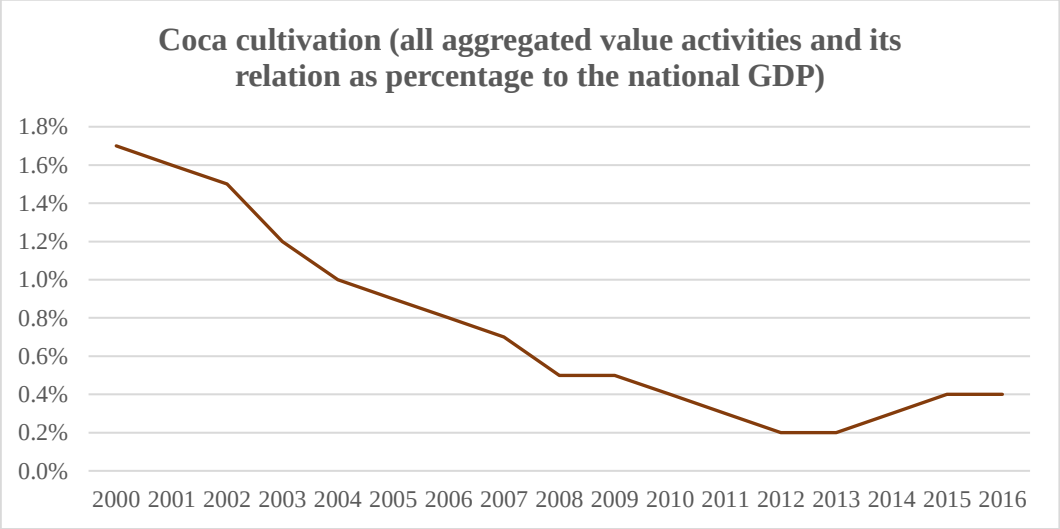

Table 8: Coca Cultivation and National GDP

The (Figure 7) reports a steady decrease in the added coca cultivation value until 2014, despite the relevant increases of coca hectares cultivated in 2007 (see figure 5). Also, the severe increase of coca cultivation from 2013 to 2016 (see figure 5), doubled the estimated aggregate value of coca cultivation and its related activities.

The comparison of these figures to non-governmental estimations show a variance. A study published by the Study Center for Economic Development (CEDE), estimated in 2010 the market sum of all the coca-cocaine industry (including cross-border transactions), at USD 6.5 billion, representing 2.3% of the national GDP. However, concerning the cultivation of coca, this was estimated at USD 600 million, representing 0.21% of the national GDP (Mejia & Rico, 2010, p. 23).

3.3 Economic development Colombia

As the data analysis in this paper is based on regional economic data, this chapter serves as background information and describes in a general sense the national economic development in Colombia from 2005 to 2016, expected to be reflected in the analyzed regions.

The same simple visual exercise done in previous studies, comparing the development of the coca cultivation and national GDP (see Figure 8), might suggest the economic deceleration is related somehow to the increase in coca cultivation.

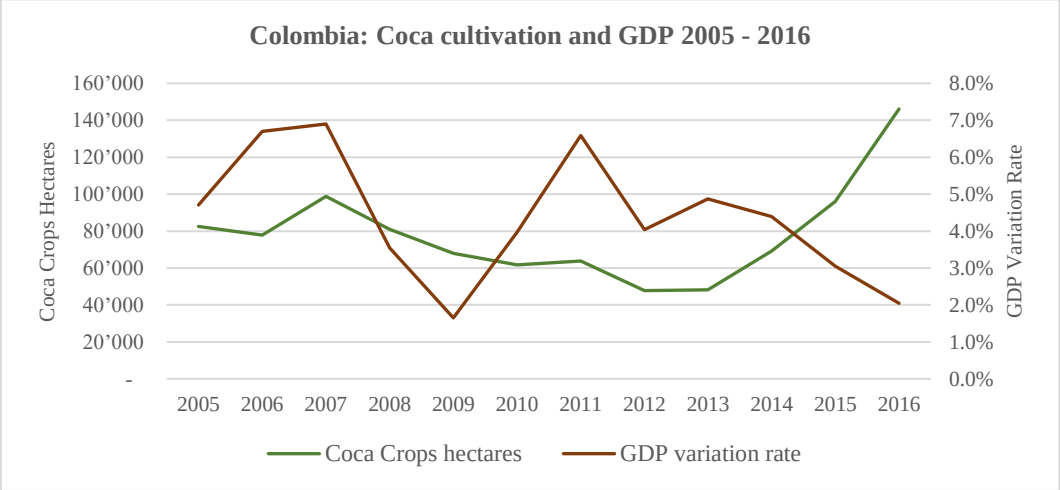

Table 9: Colombia coca cultivation and GDP 2005 – 2016 (Source DANE)

The graph also shows that from 2005 to 2016, the Colombian economy experienced constant economic growth, increasing the national GDP from USD 145 billion in 2005 to USD 282 billion in 2016 (CEPALSTAT, 2019). The economic deceleration from 2007 to 2009 is related to the global financial crisis of 2008 (Arango, Mejía, Bacarreza, & García, 2016, p. 12). Compared to other Latin American countries, Colombia reported a stable inflation rate, due to its monetary policy that has contributed to the development of the financial sector (see figure 9) (Kalmanovitz, 2017, Chapter 14).

Nevertheless, the economic growth rate since 2012 has been decreasing, principally due to the lower international prices of raw materials in the mining sector, primary exports goods of Colombia (H. J. Gómez & Higuera, 2018, p. 13). The fall on the international oil prices has affected the state finances, aggravating the fiscal deficit, and imitating the public investments (Córdoba, Acosta, Valenzuela, & Uribe, 2016). The dependency on raw materials has not only affected the stability of public finances but has also reduced the competitiveness of other economic sectors, mainly the agriculture production and manufacture industry (Kalmanovitz, 2017, Chapter 20).

The loss of competitiveness in the agriculture sector is also suggested to be related to the concentration of rural land, as 1% of all the rural properties concentrate 43% of the productive land (Junguito, Perfetti, & Becerra, 2014, p. 52). Only 24% of the agricultural land in Colombia is estimated to be exploited for legal agriculture production (Junguito, Perfetti, & Becerra, n.d., p. 52). The purchases of rural land with illicit profits from cocaine trafficking has been a crucial factor sustaining these circumstances (García Ricardo Rocha, 2003, p. 299).

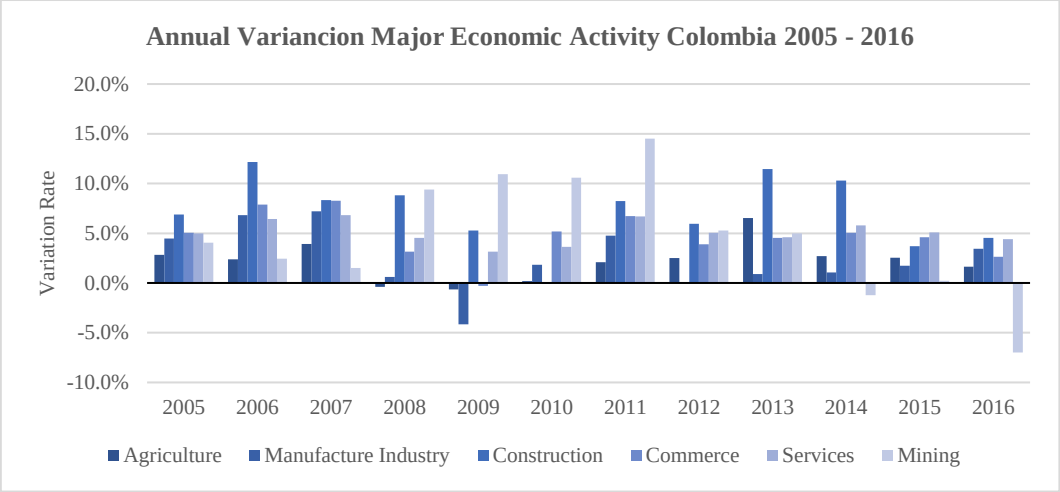

Table 10: Annual variation major economic activity (Source DANE)

To summarize, as seen in figure 9, the economic development of the last decade in Colombia has been based primarily in the mining sector.

4 Methodology

To measure the relationship between coca cultivation and sectorial regional GDP, as well the relationship between coca cultivation and unemployment rate. Furthermore, to estimate how the coca cultivation and the sectorial GDP are related, two different methods are being employed.

These are complemented in advance by a short descriptive statistical analysis, intended to compare the economic development of the regions.

4.1 Correlation analysis

First, the relationship between the two variables, coca cultivation and sectorial GDP, as well coca cultivation and unemployment rate, is measured with the correlation analysis, expressed through the Pearson correlation coefficient (Anderson, 2009, p. 91). The cross-regional data includes eight regions with high reported coca crops on their territory (defined as "coca regions") and eight regions with no or very low reported coca cultivation for the years 2005 and 2016.

The correlations between coca cultivation and regional sectoral GDP, as well as coca cultivation and unemployment rate, are run once with the variable coca cultivation (hectares) and also with the variable coca cultivation (estimated income), that allows to take into consideration the regional differences in the crop yield, due to regional geographical features (UNODC, 2018c, p. 31).

4.2 Regression analysis

The relation between the two variables is estimated through the linear regression equation (Anderson, 2009, p. 494), where the sectorial GDP is defined as the dependent variable and the coca cultivation act as the independent variable. The regression analysis, for the times series 2005 to 2016, includes coca regions and no coca regions and is also run once with the variable coca cultivation (hectares), and the variable coca cultivation (estimated income).

The linear regression equation is estimated using the least squares method (Anderson, 2009, p. 498). The method used to predict the sectorial GDP using the variable coca cultivation (hectares and income). It is necessary to consider several unknown independent variables, such as private or public investments, public policies, regional characteristics,

among others, that also affect the sectorial GDP. For this reason, the model includes dummy variables to consider these unknown independent variables (Anderson, 2009, p. 586).

As the regression using the least square method is run in EXCEL, two regions had to be excluded. Due to the technical limitations in EXCEL, "Data Analysis Tool Regression," of 16 variables (Matthäus & Schulze, 2011, p. 141).

As dummy variables are used, they need to be coded as 1 and 0, to represent each respective value of the regions included in the model, and as there are 14 regions in the model, 13 dummy variables are necessary (Anderson, 2009, p. 586). The regression, for the times series 2005 to 2016, including 16 variables (14 regions), is run in EXCEL based on the following data organization (see table) (only represented for two years as an example) To determine the estimated regression equation:

$$\hat{y} = b_0 + b_1x_1 + b_2x_2 + \ldots + b_px_p$$

The regression analysis through the estimated regression equation allows analyzing how the dependable variable is related to the independent variables (Anderson, 2009, p. 611). Being relevant for the analysis, the relation between sectorial GDP and the coca crops.

Year	**Sectorial GDP**	**Region 1**	**Region 2**	**…**	**Region 14**	**Coca crops (hectares or estimated income)**
2005	Value Region 1	1	0	0	0	Value Region 1
2005	Value Region 2	0	1	0	0	Value Region 2
2005	…	0	0	1	0	…
2005	Value Region 14	0	0	0	1	Value Region 14
2006	Value Region 1	1	0	0	0	Value Region 1
2006	Value Region 2	0	1	0	0	Value Region 2
2006	…	0	0	1	0	…
2006	Value Region 14	0	0	0	1	Value Region 14

Table 11: Data organization regression model

4.3 Data Description

4.3.1 Coca crops hectares

The collected and presented data for the coca crops in hectares, 2005 to 2016 comes from the Drug Information System of Colombia (SIMCI) to be highly reliable, as it based on real satellite images (SIMCI, 2019).

4.3.2 Coca cultivation estimated income

The estimated income from coca leaves is calculated based on data available provided by SIMCI as followed:

Estimated income coca cultivation = Coca crops hectares × production × coca leaf price

As the sectoral, regional GDP refers to real GDP (base-year price 2005), the coca cultivation income is calculated with the coca leave price of 2005. Meaning, the estimated income in the regression analysis represent the estimated gross income, base-year price 2005.

This is an own calculation based on data provided by the SIMCI, if this income should represent the regional income from coca leaves, it necessary to assume that: That there is no seizures or production loss, and in all regions, farmers sell its total coca leaf production, without processing into coca paste or cocaine base.

2005	**Hectares**	**Production (coca leaves kg/ha)**	**Prices coca leaf (COP)**	**Estimated Income (COP billions)**
Caqueta	4988	5600	2552.85	71.31
Cauca	2705	2600	2552.85	17.95
Choco	1025	2600	2552.85	6.80
Cordoba	3136	6600	2552.85	52.84
Guaviare	8658	9900	2552.85	218.82
Nariño	13875	2600	2552.85	92.09
Norte de Santander	844	4600	2552.85	9.91
Putumayo	8963	5600	2552.85	128.13
2016	**Hectares**	**Production (coca leaves kg/ha)**	**Prices coca leaf (COP)**	**Estimated Income (COP billions)**
Caqueta	9343	3700	2552.85	88.25
Cauca	12595	5600	2552.85	180.06
Choco	1803	5600	2552.85	25.77
Cordoba	2668	4300	2552.85	29.29
Guaviare	6838	4400	2552.85	76.81
Nariño	42627	5600	2552.85	609.40
Norte de Santander	24831	5400	2552.85	342.30
Putumayo	25162	3700	2552.85	237.67

Table 12: Estimated Income coca cultivation (Source SIMCI)

4.3.3 Coca cultivation and cocaine production

These focus on coca cultivation, excluding cocaine production, has the advantage of the data reliably and geographical delimitations. The Coca crops are monitored since 1999 with satellite technologies, on field information and aerial monitoring by the Integrated Illicit Crops Monitoring System (SIMCI). Coca crops are a reliable adequate variable for regional analysis, as they are located in the region and can be analyzed directly to other regional variables. Therefore the correlations and regression analysis also include the variable coca cultivation in hectares.

On the contrary, cocaine production can only be potentially estimated. As the manufactured process needs to be quantified in three main steps: The potential output of the harvested coca crops, the potential process capacity to convert coca leaves into basic cocaine paste, and the efficiency to process the paste into cocaine hydrochloride. Additionally, there is no certainty that all production steps are performed in the same region. (SIMCI-UNODC, 2018, p. 140).

The advantages and disadvantages of this approach will be discussed further on in the discussion section.

4.3.4 Selected Provinces:

From 2005 to 2016, coca cultivation was reported in 24 of 32 Colombian provinces. However, for the analysis, only 16 were chosen.

The coca regions were chosen, primarily du the criteria of its economic size, no more than 2% relative to the national GDP[2], assuming coca cultivation has a higher impact in smaller economies.

4.3.5 Selected sectoral GDPs:

The data source for the regional GDP, in the local currency Colombian Peso (COP) (real GDP base-year price 2005))and the unemployment figures are the Colombian National Department of Statistics (DANE, 2019)

The economic sectors for the analysis were selected according to the cited findings from the previous studies.

[2] See Apendix A

4.4 Research questions

The described methodology assists in answering the central question of this paper: How has illegal coca cultivation impacted the Colombian economy on a regional level?

Also, complementary questions as; How changes in the number of coca crops affect specific formal economic sectors? Are there negative or positive effect depending on the sector? Moreover, are the observed effects similar in every region?

The correlation coefficient expresses the relationship between the coca crops on the formal economy if a relationship exists, and if this relationship is positive or negative (Johnson & Kuby, 2012, p. 136).

The regressions analysis allows to describe the relationship between the coca crops and the formal economy, and predict how a change in the coca crops affects, negatively or positively, the formal economy (Anderson, 2009, p. 560).

About the cited literature findings and the postulated questions, it is expected to observe a displacement of the formal economy related to the coca crops. The correlation and regression analysis will assist in providing clarity, which sector might be the most affected, additionally if there is even specific sector that might be benefiting from coca cultivation, and finally, are the effects observed equally in every region.

5 Results

5.1 Descriptive Data Summary

The following table shows the summarized economic development of the 16 observed regions for the times series 2005 to 2016.

5.1.1 Economic Development

The economic development, using the trend growth as a comparable variable (Mankiw & Taylor, 2014, p. 476), shows no particular pattern. The regions where coca increased or decreased, reported similar trend growths as regions without coca cultivation.

Trend Growth Coca Cultivation and Sectoral GDPs 2005 - 2016							
Region	**Coca Crops Hectares**	**GDP**	**Agriculture**	**Manufacture Industry**	**Construction**	**Commerce**	**Services**
Amazonas	-81%	42%	-24%	n.d.	n.d.	65%	37%
Caldas	-100%	34%	33%	5%	119%	49%	29%
Caquetá	87%	69%	18%	11%	553%	54%	36%
Cauca	366%	85%	23%	79%	442%	57%	75%
Cesar	-	68%	-2%	39%	76%	68%	86%
Chocó	76%	48%	4%	29%	150%	76%	44%
Colombia	77%	59%	26%	26%	112%	65%	73%
Córdoba	-15%	36%	26%	4%	71%	52%	62%
Guaviare	-21%	30%	-94%	38%	107%	100%	53%
Huila	-	43%	37%	17%	181%	83%	70%
Magdalena	-84%	50%	7%	34%	45%	49%	67%
Nariño	207%	57%	22%	20%	74%	50%	62%
Norte Santander	2842%	60%	9%	37%	299%	46%	64%
Putumayo	181%	118%	-11%	-54%	150%	84%	84%
Quindío	-	57%	25%	29%	197%	49%	72%
Risaralda	-	48%	24%	42%	32%	59%	60%
Sucre	-	62%	25%	23%	151%	61%	77%

Table 13: Trend growth coca cultivation and sectoral GDP (Source DANE)

For the interpretation of the results, it is crucial to supplement the information with the annual average of coca hectares cultivated in each region. As seen above, in some regions coca cultivation might have increased largely (Choco by 76%), but on average, the reported a lower area affected by coca cultivation.

Coca Cultivation hectares 2005 – 2016 Annual Average							
Amazonas	337	Choco	1893	Magdalena	120	Risaralda	-
Caldas	71	**Colombia**	**74718**	Nariño	17918	Sucre	-
Caqueta	4993	Cordoba	1743	Norte de Santander	4310		
Cauca	5312	Guaviare	6809	Putumayo	10845		
Cesar	7	Huila	-	Quindio	-		

Table 14: Coca cultivation hectares 2005 - 2016 annual average (Source SIMCI)

The summarize of the times series data through the annual average growth rate, also show no particular pattern between the different regions regarding their main economic activities.

Annual Average Economic Growth Selected Regions 2005 - 2016						
Region	Average Annual Growth Rate Coca Hectares	Annual Average Economic Growth Rate Main Economic Activity				
		GDP	Agriculture	Manufacture Industry	Commerce	Services
Amazonas	-1.1%	3.4%	-2.1%	2.0%	4.7%	6.4%
Caldas	-18.8%	3.2%	2.1%	0.9%	3.6%	3.2%
Caqueta	5.6%	4.3%	2.2%	2.0%	3.9%	2.6%
Cauca	26.8%	5.5%	4.2%	4.9%	4.5%	6.2%
Cesar	-	4.9%	0.6%	2.0%	4.7%	6.1%
Choco	24.7%	3.5%	1.4%	2.1%	5.3%	4.5%
Colombia	9.5%	4.4%	2.0%	2.6%	4.9%	5.1%
Cordoba	25.2%	3.1%	0.6%	0.5%	4.4%	5.7%
Guaviare	2.0%	2.9%	-21.2%	2.4%	5.8%	3.2%
Huila	-	3.0%	3.1%	0.8%	5.2%	4.8%
Madgalena	-18.7%	4.1%	1.2%	3.1%	4.0%	4.6%
Nariño	12.3%	3.9%	1.7%	1.9%	3.7%	4.7%
Norte de Santander	31.5%	3.7%	1.8%	2.6%	3.0%	4.4%
Putumayo	25.4%	6.8%	0.8%	-3.8%	5.8%	5.4%
Quindio	-	3.4%	0.5%	2.2%	4.5%	4.8%
Risaralda	-	3.4%	2.8%	4.1%	4.7%	4.7%
Sucre	-	4.5%	3.1%	2.3%	4.8%	5.4%

Table 15: Annual average economic growth selected regions 2005 – 2016 (Source DANE)

In observation of the sub-sectoral GDPs, a particular trend is observed in livestock production. The livestock production growth tended to be positive as coca cultivation increased, but negative as coca cultivation decreased.

Trend Growth Sub-Activites Agriculture and Coca Cultivation 2005 - 2016			
Region	**Coca Crops Hectares**	**Cultivation Other Agriculture Products (excluded cafe)**	**Livestock Production**
Amazonas	-81%	n.d.	-100%
Caldas	-100%	26%	19%
Caquetá	87%	3%	24%
Cauca	366%	20%	22%
Cesar	-	-4%	-15%
Chocó	76%	33%	-11%
Colombia	77%	10%	24%
Córdoba	-15%	17%	-2%
Guaviare	-21%	0%	0%
Huila	-	3%	-2%
Magdalena	-84%	0%	-9%
Nariño	207%	5%	22%
Norte Santander	2842%	8%	15%
Putumayo	181%	-7%	63%
Quindío	-	-4%	52%
Risaralda	-	-2%	34%
Sucre	-	6%	23%

Table 16: Trend growth sub-activities agriculture and coca cultivation 2005 - 2016) (Source DANE)

5.1.2 Unemployment Rate

Regarding the unemployment rate, no pattern is observed. In regions were coca increased, the unemployment rate shows no particular higher or lower rate, neither in the reported annual rates or in the variation from 2005 to 2016.

Coca Cultivation and Unemployment Rate				
Region	**Trend Growth Coca Crops Hectares 2005 - 2016**	**% 2005**	**% 2016**	**Varia-tion**
Amazonas	-81%	n.d.	n.d.	n.d.
Caldas	-100%	14.0	9.3	-4.72
Caqueta	87%	10.3	8.2	-2.06
Cauca	366%	9.7	7.9	-1.74
Cesar	-	11.3	11.5	0.20
Choco	76%	10.5	10.7	0.19
Colombia	77%	11.8	9.2	-2.61
Cordoba	-15%	12.3	9.7	-2.54
Guaviare	-21%	n.d.	n.d.	n.d.
Huila	-	11.8	8.0	-3.78
Madgalena	-84%	6.4	8.4	1.99
Nariño	207%	11.6	7.6	-4.01
Norte de Santander	2842%	13.2	12.6	-0.59
Putumayo	181%	n.d.	n.d.	n.d.
Quindio	-	19.5	13.9	-5.60
Risaralda	-	14.3	9.3	-5.02
Sucre	-	6.0	9.4	3.39

Table 17: Coca cultivation and the unemployment rate (Source DANE)

5.1.3 Times Serie Data Overview

The development of the coca cultivation at the regional level of the main coca regions (regions where coca cultivation was on average over 1'000ha) shows three interesting developments.

First, the significant increase in the Pacific region, Cauca and Nariño. In contrast to the relatively stable development of Choco, also located in the Colombian Pacific[3].

Second, contrary to the development in most main coca regions, in Cordoba and Guaviare, the coca cultivation decreased from 2005 to 2016.

Finally, the severe increase reported in Norte de Santander, increasing from 844ha in 2005 to 24'831ha in 2016.

However, these developments are not reflected at first sight in the economic development or the unemployment rate, which suggest that in overall the economic development trend of these regions remained similar to the national economy.

[3] See Appendix A

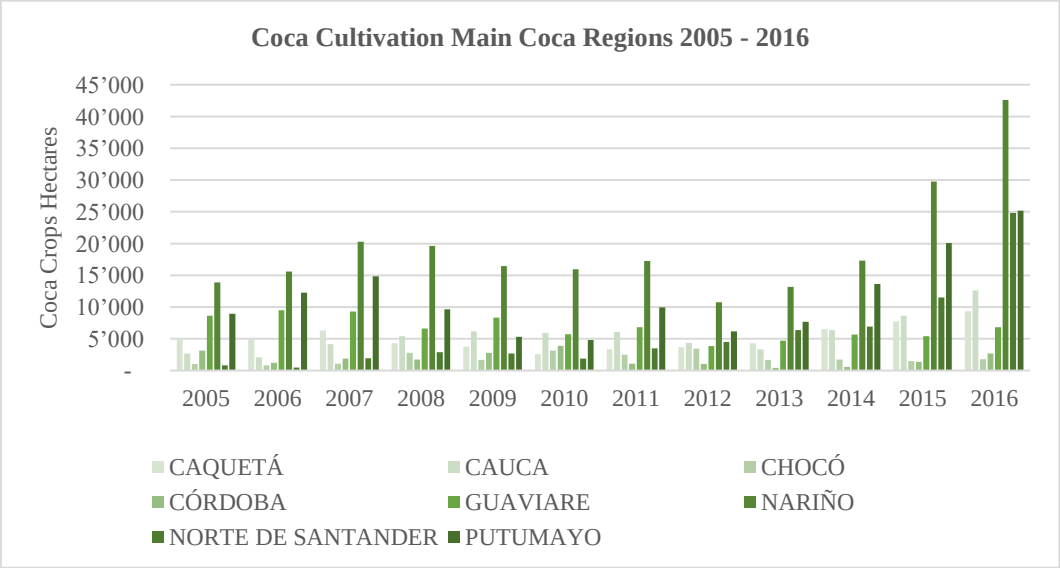

Table 18: Coca cultivation main coca regions 2005 – 2016 (Source DANE)

The development of the regional GDP over the time series shows that the coca regions had in overall the same trend as the national economy. The graph also permits to observe already a difficulty in the data analysis, not considered variables in the model, such as the mining sector. The development of the mining sector , explains the variations in Choco and Putumayo, regions with important mining activity (DANE, 2019).

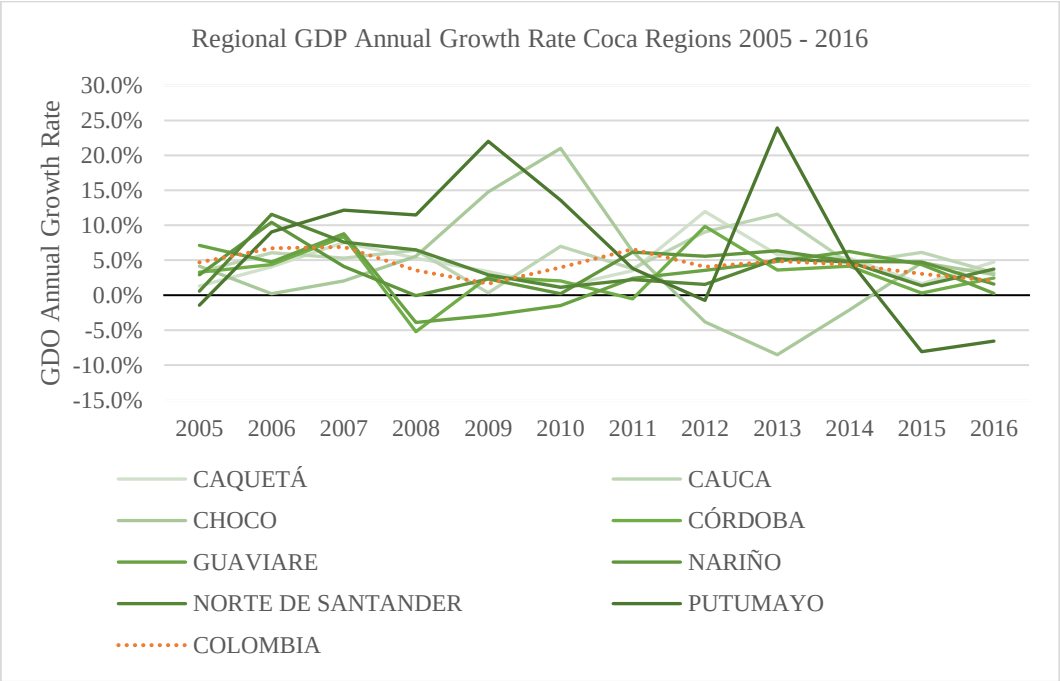

Table 19: Regional GDP annual growth rate coca regions 2005 – 2016 (Source DANE)

5.2 Correlation Analysis

The following chapter presents the result of the correlations analysis. The relationship is expressed through the Pearson correlation coefficient (r),[4]

5.2.1 Sectorial GDP

Correlations Coefficient (r) Coca Cultivation and Sectoral GDP				
Sectorial GDP	Coca Crops Hectares		Estimated Coca cultivation Income	
	2005	**2016**	**2005**	**2016**
Agriculture	-0.32	-0.29	-0.46	-0.20
Manufacture Industry	-0.36	-0.40	-0.49	-0.20
Comerce	-0.33	-0.31	-0.43	-0.16
Services	-0.29	-0.32	-0.42	-0.14

Table 20: Results correlation analisis sectoral GDP

5.2.2 Sub-Sectorial GDP

Correlations Coefficient (r) Coca Cultivation and Sub-Sectororal GDP				
Sub-Sectorial GDP	**Coca Crops Hectares**		**Estimated Coca cultivation Income**	
	2005	**2016**	**2005**	**2016**
Cultivation of agriculture products	-0.21	-0.21	-0.26	-0.02
Livestock production	-0.32	-0.24	-0.38	-0.13
Food, beverages and tobacco production	-0.36	-0.39	-0.47	-0.18
Construction (buildings and residences)	-0.41	-0.36	-0.56	-0.18
Comerce (only resale activities)	-0.36	-0.36	-0.42	-0.23
Real state Services	-0.33	-0.33	-0.47	-0.13
Privat education expenses	-0.35	-0.31	-0.51	-0.19

Table 21: Results correlation analisis sub-sectoral GDP

5.2.3 Unemployment Rate

Correlations Coefficient (r) Coca Cultivation and Unemployment Rate				
Unemployment Rate	**Coca Crops Hectares**		**Estimated Coca cultivation Income**	
	2005	**2016**	**2005**	**2016**
Unemployment Rate	0.04	-0.14	0.07	-0.20

Table 22: Results correlation anlisis umeemployment rate

[4] See Appendix B and C for calculation sheets

5.3 Regression Analysis

The results of the regression analysis cannot be taken into account for the estimation of the linear regression equation, as the results in all regressions run in EXCEL are not statistically significant. The following table present as an example, the summary output for the agriculture GDP.

SUMMARY OUTPUT: Agriculture GDP and Coca Cultivation Hectares

Regression Statistics	
Multiple R	0.983730685
R Square	0.96772606
Adjusted R Square	0.964772889
Standard Error	0.117924881
Observations	168

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	14	63.7973696	4.556954971	327.690494	2.5318E-106
Residual	153	2.127660471	0.013906278		
Total	167	65.92503007			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	2.905346999	0.034220616	84.90048808	1.3219E-130	2.837741082	2.972952917	2.837741082	2.972952917
Caquetá	-0.400785899	0.056739368	-7.063629986	5.34493E-11	-0.512879644	-0.288692153	-0.512879644	-0.288692153
Cauca	-0.022081039	0.056835875	-0.38850531	0.698182204	-0.134365443	0.090203365	-0.134365443	0.090203365
Cesar	0.033172532	0.050893202	0.651806741	0.515503784	-0.067371584	0.133716648	-0.067371584	0.133716648
Córdoba	0.240819657	0.054437676	4.423768127	1.83229E-05	0.133273111	0.348366204	0.133273111	0.348366204
Guaviare	-2.206488214	0.057383769	-38.4514341	1.56928E-80	-2.319855032	-2.093121396	-2.319855032	-2.093121396
Huila	0.126772543	0.06251638	2.027829227	0.044313061	0.003265788	0.250279297	0.003265788	0.250279297
Magdalena	0.077223282	0.049954619	1.545868721	0.12420219	-0.021466578	0.175913143	-0.021466578	0.175913143
Nariño	0.108265584	0.059658449	1.814756934	0.071519982	-0.00959507	0.226126238	-0.00959507	0.226126238
Norte Santander	-0.006198755	0.056013161	-0.110666043	0.912026208	-0.116857813	0.104460303	-0.116857813	0.104460303
Putumayo	-0.961995558	0.058356675	-16.48475623	9.57666E-36	-1.077284439	-0.846706676	-1.077284439	-0.846706676
Quindío	-0.191830814	0.06251638	-3.068488841	0.002545489	-0.315337569	-0.06832406	-0.315337569	-0.06832406
Risaralda	-0.109315015	0.06251638	-1.748581964	0.082368922	-0.232821769	0.01419174	-0.232821769	0.01419174
Sucre	-0.237372652	0.06251638	-3.796967328	0.000210723	-0.360879407	-0.113865897	-0.360879407	-0.113865897
Coca Cultivation Hectares	-0.003760026	0.009097533	-0.413301745	0.679964236	-0.021733025	0.014212972	-0.021733025	0.014212972

Table 23: Summary Output Regression Agriculture GDP

The relation between the coca cultivation in hectares (ha) and the agriculture GDP based on the results of the model, would formulate that, (if all other predictors remain constant); If the coca cultivation increases by 1ha, the agricultural GDP decreases by 0.4% on average.

6 Discussions of Results

The results of the data analysis presented in the previous chapter need to be interpreted in order to size an answer for the postulated question in this paper.

In this sense, the main question: How has coca cultivation affected the Colombian economy on a regional level? Can be discussed based on the previously cited conclusion from Rocha (2003), stating that the repatriated illicit funds from drug trafficking have not affected the national sectoral composition of the economy. Second, also concluded by Rocha (2011), that drug trafficking has decelerated formal economic growth. Lastly, in Peru Concepción and Pedroni (2011) concluded that the net-effect balance between cocaine production and formal economy on the national level is close to zero, but with slightly different results observed at the regional level.

The cited studies base their conclusion, on illicit financial flows and cocaine production. Also, other statistical methods were implemented, but the conclusions can still be used as a base and reference for interpreting the results of this paper.

6.1 Economy sectoral composition

The data analyzed, show (table 13) that even though coca cultivation increased from 2005 to 2016, in regions like Cauca by 366 %, or Norte de Santander by even considerable 2842%, the economic growth of the regional economy, and its main formal activities show no significant difference to the economic development, or to other regions without coca cultivation like Quindio and Sucre. In addition, if the development of the coca regions is compared to the national one, it is observed that the low productivity in the agriculture sector and manufacture industry seem to be related to structural trends of the Colombian economy (see chapter 3.3 Economy development Colombia).

Nevertheless, as Rocha (2003) also concluded, at the regional level, the concentration of land can be related to drug trafficking, and not promote agriculture cultivation, but livestock production. This relationship might be observed through the fact that in the regions (table 16) where coca cultivation increased, Cauca by 366%, Nariño by 207% and Putumayo by 181%, the livestock production increased. However, in regions were coca cultivation decreased, Cordoba by -15%, Magdalena by – 84% or coca cultivation does not exist (according to the data), Cesar, livestock production decreased. This is only an

observation that will require further analysis to establish a clear relation between coca cultivation and livestock production.

6.2 Deceleration formal economy

The results of the correlation analysis suggest that coca cultivation might decelerate the development of the formal economy. As seen in the results (table 20, 21, and 22) , every correlation coefficient (r) indicates a negative linear relationship. The relationship is therefore explained, as coca cultivation increases, the sectoral and sub-sectoral regional GDPs decreases. However, the relationship measured is primarily a weak or moderate negative relationship, meaning that the impact could not be significant. Also, the correlation only explains the relationship but no causality.

However, there is no precise observation of which sector might be affected the most. For example, the manufacturing industry (table 20) tends to show a moderate negative relationship with the coca cultivation in hectares, compared to other main economic activities where results show a rather weak relationship. However, in the coefficient for the variable "estimated coca cultivation income" (table 21), all main activities appear to have the same level of relationship.

The same is observed for the sub-economic activities, where agriculture sub production activities tend to have a lower coefficient, but no other clear pattern is observed.

The results for the unemployment rate (table 22), show that in 2005, there is no relationship, meaning that, as coca cultivation increases or decreases the unemployment rate remains unchanged. In 2016, the weak negative relationship can be interpreted in a positive economic sense, as coca cultivation increases the unemployment decreases.

The results also show (table 18) that despite coca cultivation was much higher in 2016 (126'000ha) than in 2005 (46'000ha), the coefficients show no significant change. This can also be interpreted as a weak relationship to coca cultivation. The severe increase in the coca cultivation seems not to have restrained the formal economic growth significantly.

The variance of the coefficient between coca cultivation in hectares can be explained due to the crop yield (table 12). In 2005, the correlation using the variable estimated income tended to be higher than the ones in 2016, since coca cultivation increased, but the crop

yield decreased, and therefore the actual coca cultivation output maintained relatively stable.

This last statement also shows a disadvantage of basing the analysis of coca cultivation and not potential cocaine production. The estimated potential cocaine production has a higher aggregate value than the coca leaves. Therefore, the expected higher income may be observed in the higher correlation coefficient.

6.3 Challenges

The non-significant statistically result of the regression analysis (table 23) reflects the complexity and challenges involved in the estimation of licit-illicit market relationships.

The complexity to estimated the illicit activities as described (Chapter 3.2 Coca cultivation and national GDP) pose a significant difficulty in the construction of a reliable regression model. In the regression model proposed in this paper, the independent variable used was coca cultivation in hectares, a reliable variable that can be assigned to a specific region, but that only represents in a sense the size of the cocaine market. The variable "estimated coca cultivation income" was included to consider regional differences in the production output of coca yields. Other variables such as potential cocaine production include more production factors that might result in a more precise impact analysis on the national level, but reduce the approach of the regional analysis. The potential cocaine production is known not to be limited regionally, meaning the coca leaves from the coca cultivation in region A, might be processed in region B, affecting the regional distribution of income.

Not only the illicit economy poses a challenge for the regression model, but also the formal legal economy and its influence factors, factors that were not included in the model. The sectoral and sub-sectoral GDP is itself a dependent variable from many economic, social, and political events and incidences. All these variables cannot be included totally by dummy variables, affecting the significance of the results.

Besides, as, Concepción and Pedroni (2011) suggested, the reverse relation needs to be considered. Where the coca cultivation is a dependent variable from the formal GDP, meaning the coca cultivation value (hectares or income), as an endogenous variable (Mankiw & Taylor, 2014, p. 22), depends and is affected by the changes in the GDP.

7 Conclusion

In this paper, an effort was made to analyze the economic impact of coca cultivation on the regional level in Colombia. The effects of drug trafficking on the economy, precisely cocaine trafficking, have been the subject of numerous analysis, as presented and discussed in this paper. These previous analyses, however, tends to focus on repatriated illicit financial flows from cocaine trafficking, and therefore, direct their analysis, on national level aggregated data.

These paper focused its analysis on Colombia since the 1980s known, unfortunately, as the main global cocaine supplier. The papers base its analysis not on illicit financial flows, but coca cultivation, a variable that can be reliably assigned to a specific region. The conducted correlation, and regressions analysis, for the time series 2005 to 2016, were used as the statistic methods to measure the relationship and relation between coca cultivation and regional sectorial GDPs.

The results show that despite the increases of coca cultivation, regions with coca crops show no significant overall difference in their economic development as other Colombian regions with similar macroeconomic characteristics. The findings of the correlation analysis, suggest a weak linear negative relationship between the two variables, meaning coca cultivation might decelerate the formal economy growth. However, the proposed regression model using dummy variables to estimated the causation in this relationship was not large enough to express significant results.

The limitations established in this paper are, in part, responsible for the non-significant results. These results need to be considered within the limitations of this paper, as other macroeconomic variables that affect the regional GDP were not considered, as other factors related to the cocaine market, such as potential cocaine production, were also excluded. The paper only focused its analysis on coca cultivation in hectares and the estimated coca cultivation income. The estimated income calculated in this paper was base under assumptions, that also not reflect the size of the market entirely. This approach was taken deliberately in order to facilitate a regional analysis that might portray possible effects.

The findings of this paper might not be substantial and significant enough to give a clear answer to how coca cultivation affects the regional economy. Nonetheless, it assists in reinforcing previous findings, in the sense that an illicit activity, such as coca cultivation

serving drug trafficking, might not affect the sectoral structure of the regional economy, but show a possible decelerating effect on productive sectors. In order to establish clarity between these two variables and measure their relation, the future analysis needs to postulate a more extensive regression model, capable of obtaining significant results.

At the regional level, the future required analysis are necessary to understand how coca cultivation affects economic development and assist with public policies on how coca cultivation could be eradicated and substitute for regular production activities that contribute to the regional economic and social development.

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Appendix

Appendix A: Selected Regions and Sectoral GDP

GDP sector and sub-sector	Description
Agriculture	Use and production of vegetal and animal resources.
cultivation of agriculture products	All cultivation activities (excluding cafe).
livestock production	Livestock and milk production.
Manufacture Industry	Transformation of raw materials into consumer goods.
Food, beverage, and tobacco	Production of food products, including tobacco.
Construction	All activities related to the construction (excluding civil works).
Commerce	Resales activities (industrial and consumable goods), mechanical services, hotels, restaurants, and bars.
Commerce (only resale activities)	Commerce excluding mechanical services on private goods, hotels, restaurants, and bars.
Services	Financial and insurance services, real state services moreover, other business services.
Real State Services	Only services related to rental or sale of residential also, no-residential building.
Privat education expenses	Expenses for privat education services and privat educative instututions.

Province	Regional GDP in relation to the National GDP	Annual average hectares coca crops 2005 - 2016
Amazonas	0.07%	364
Caldas	1.57%	98
Caquetá	0.44%	5154
Cauca	1.53%	5651
Cesar	1.89%	8
Chocó	0.42%	1931
Córdoba	1.87%	1813
Guaviare	0.09%	6785
Huila	1.80%	0
Magdalena	1.31%	133
Nariño	1.54%	19378
Norte Santan-der	1.67%	5701
Putumayo	0.44%	11533
Quindío	0.77%	0
Risaralda	1.51%	0
Sucre	0.79%	0

Coca

Appendix B: Correlation Analysis Coca cultivation hectares

Agriculture	2005	2005	2016	2016	Log 2005	Log 2005	Log 2016	Log 2016
	GDP	**Coca hectares**	**GDP**	**Coca ha**	**COP**	**Coca ha**	**COP**	**Coca ha**
Amazonas	42	897	32	166.77	1.62324929	2.952792443	1.505149978	2.222117929
Caldas	712	189	949	0.001	2.852479994	2.276461804	2.977266212	-3
Caquetá	291	4988	343	9343.11	2.463892989	3.697926445	2.53529412	3.970491462
Cauca	748	2705	922	12595.44	2.873901598	3.432167269	2.964730921	4.100213343
Cesar	886	0.001	865	26.4	2.947433722	-3	2.937016107	1.421603927
Chocó	316	1025	329	1802.84	2.499687083	3.010723865	2.517195898	3.255957185
Córdoba	1159	3136	1458	2668.29	3.064083436	3.496376054	3.163757524	3.426233029
Guaviare	34	8658	2	6837.99	1.531478917	3.937417581	0.301029996	3.834928461
Huila	1014	0.001	1393	0.001	3.006037955	-3	3.143951116	-3
Magdalena	924	213	987	34.93	2.965671971	2.328379603	2.994317153	1.543198586
Nariño	941	13875	1146	42627.38	2.973589623	4.142232992	3.059184618	4.62968864
Norte Santander	746	844	815	24830.61	2.872738827	2.926342447	2.911157609	4.394987389
Putumayo	99	8963	88	25162.41	1.995635195	3.952453396	1.944482672	4.400752235
Quindío	453	0.001	566	0.001	2.656098202	-3	2.752816431	-3
Risaralda	587	0.001	725	0.001	2.768638101	-3	2.860338007	-3
Sucre	423	0.001	527	0.001	2.626340367	-3	2.721810615	-3
Correlation		-0.175893693		0.032926095		-0.321527761		-0.29356252

Cultivation of agriculture products	2005	2005	2016	2016	Log 2005	Log 2005	Log 2016	Log 2016
	GDP	**Coca hectares**	**GDP**	**Coca ha**	**COP**	**Coca ha**	**COP**	**Coca ha**
Amazonas	3	897	0.1	166.77	0.477121255	2.952792443	-1	2.222117929
Caldas	140	189	309	0.001	2.146128036	2.276461804	2.489958479	-3
Caquetá	66	4988	62	9343.11	1.819543936	3.697926445	1.792391689	3.970491462
Cauca	282	2705	241	12595.44	2.450249108	3.432167269	2.382017043	4.100213343
Cesar	349	0.001	344	26.4	2.542825427	-3	2.536558443	1.421603927
Chocó	101	1025	88	1802.84	2.004321374	3.010723865	1.944482672	3.255957185
Córdoba	462	3136	735	2668.29	2.664641976	3.496376054	2.866287339	3.426233029
Guaviare	26	8658	1	6837.99	1.414973348	3.937417581	0	3.834928461
Huila	405	0.001	372	0.001	2.607455023	-3	2.57054294	-3
Magdalena	391	213	440	34.93	2.592176757	2.328379603	2.643452676	1.543198586
Nariño	453	13875	511	42627.38	2.656098202	4.142232992	2.7084209	4.62968864
Norte Santander	483	844	501	24830.61	2.683947131	2.926342447	2.699837726	4.394987389
Putumayo	65	8963	39	25162.41	1.812913357	3.952453396	1.591064607	4.400752235
Quindío	133	0.001	213	0.001	2.123851641	-3	2.328379603	-3
Risaralda	133	0.001	167	0.001	2.123851641	-3	2.222716471	-3
Sucre	153	0.001	188	0.001	2.184691431	-3	2.274157849	-3
Correlation		-0.009908731		0.195101634		-0.214217917		-0.202643149

Livestock production	2005	2005	2016	2016	Log 2005	Log 2005	Log 2016	Log 2016
	GDP	**Coca hectares**	**GDP**	**Coca ha**	**COP**	**Coca ha**	**COP**	**Coca ha**
Amazonas	1	897	2	166.77	0	2.952792443	0.301029996	2.222117929
Caldas	166	189	197	0.001	2.220108088	2.276461804	2.294466226	-3
Caquetá	193	4988	239	9343.11	2.285557309	3.697926445	2.378397901	3.970491462
Cauca	157	2705	192	12595.44	2.195899652	3.432167269	2.283301229	4.100213343
Cesar	487	0.001	413	26.4	2.687528961	-3	2.615950052	1.421603927
Chocó	72	1025	64	1802.84	1.857332496	3.010723865	1.806179974	3.255957185
Córdoba	658	3136	643	2668.29	2.818225894	3.496376054	2.808210973	3.426233029
Guaviare	5	8658	5	6837.99	0.698970004	3.937417581	0.698970004	3.834928461
Huila	170	0.001	167	0.001	2.230448921	-3	2.222716471	-3
Magdalena	471	213	429	34.93	2.673020907	2.328379603	2.632457292	1.543198586
Nariño	247	13875	301	42627.38	2.392696953	4.142232992	2.478566496	4.62968864
Norte Santander	182	844	210	24830.61	2.260071388	2.926342447	2.322219295	4.394987389
Putumayo	19	8963	31	25162.41	1.278753601	3.952453396	1.491361694	4.400752235
Quindío	147	0.001	223	0.001	2.167317335	-3	2.348304863	-3
Risaralda	189	0.001	253	0.001	2.276461804	-3	2.403120521	-3
Sucre	243	0.001	298	0.001	2.385606274	-3	2.474216264	-3
Correlation		-0.194719129		-0.110400319		-0.320755216		-0.241496907

Manufacture Industry	2005	2005	2016	2016	Log 2005	Log 2005	Log 2016	Log 2016
	GDP	**Coca hectares**	**GDP**	**Coca ha**	**COP**	**Coca ha**	**COP**	**Coca ha**
Amazonas	5	897	6	166.77	0.698970004	2.952792443	0.77815125	2.222117929
Caldas	999	189	1052	0.001	2.999565488	2.276461804	3.02201574	-3
Caquetá	65	4988	72	9343.11	1.812913357	3.697926445	1.857332496	3.970491462
Cauca	834	2705	1489	12595.44	2.921166051	3.432167269	3.172894698	4.100213343
Cesar	261	0.001	364	26.4	2.416640507	-3	2.561101384	1.421603927
Chocó	21	1025	27	1802.84	1.322219295	3.010723865	1.431363764	3.255957185
Córdoba	272	3136	283	2668.29	2.434568904	3.496376054	2.451786436	3.426233029
Guaviare	8	8658	11	6837.99	0.903089987	3.937417581	1.041392685	3.834928461
Huila	304	0.001	356	0.001	2.482873584	-3	2.551449998	-3
Magdalena	291	213	391	34.93	2.463892989	2.328379603	2.592176757	1.543198586
Nariño	335	13875	403	42627.38	2.525044807	4.142232992	2.605305046	4.62968864
Norte Santander	423	844	579	24830.61	2.626340367	2.926342447	2.762678564	4.394987389
Putumayo	24	8963	11	25162.41	1.380211242	3.952453396	1.041392685	4.400752235
Quindío	204	0.001	263	0.001	2.309630167	-3	2.419955748	-3
Risaralda	793	0.001	1128	0.001	2.899273187	-3	3.0523091	-3
Sucre	235	0.001	288	0.001	2.371067862	-3	2.459392488	-3
Correlation		-0.280199282		-0.009855941		-0.36881161		-0.39717384

Food, beverages and tobacco production	2005	2005	2016	2016	Log 2005	Log 2005	Log 2016	Log 2016
	GDP	**Coca hectares**	**GDP**	**Coca ha**	**COP**	**Coca ha**	**COP**	**Coca ha**
Amazonas	2	897	3	166.77	0.301029996	2.952792443	0.477121255	2.222117929
Caldas	357	189	410	0.001	2.552668216	2.276461804	2.612783857	-3
Caquetá	42	4988	47	9343.11	1.62324929	3.697926445	1.672097858	3.970491462
Cauca	288	2705	404	12595.44	2.459392488	3.432167269	2.606381365	4.100213343
Cesar	152	0.001	234	26.4	2.181843588	-3	2.369215857	1.421603927
Chocó	5	1025	11	1802.84	0.698970004	3.010723865	1.041392685	3.255957185
Córdoba	158	3136	135	2668.29	2.198657087	3.496376054	2.130333768	3.426233029
Guaviare	3	8658	6	6837.99	0.477121255	3.937417581	0.77815125	3.834928461
Huila	146	0.001	150	0.001	2.164352856	-3	2.176091259	-3
Magdalena	204	213	249	34.93	2.309630167	2.328379603	2.396199347	1.543198586
Nariño	113	13875	105	42627.38	2.053078443	4.142232992	2.021189299	4.62968864
Norte Santander	98	844	104	24830.61	1.991226076	2.926342447	2.017033339	4.394987389
Putumayo	7	8963	6	25162.41	0.84509804	3.952453396	0.77815125	4.400752235
Quindío	94	0.001	90	0.001	1.973127854	-3	1.954242509	-3
Risaralda	257	0.001	333	0.001	2.409933123	-3	2.522444234	-3
Sucre	57	0.001	61	0.001	1.755874856	-3	1.785329835	-3
Correlation		-0.335660016		-0.202676898		-0.369490756		-0.391375941

Construction (buildings and residences)	2005	2005	2016	2016	Log 2005	Log 2005	Log 2016	Log 2016
	GDP	**Coca hectares**	**GDP**	**Coca ha**	**COP**	**Coca ha**	**COP**	**Coca ha**
Amazonas	1	897	0.1	166.77	0	2.952792443	-1	2.222117929
Caldas	170	189	296	0.001	2.230448921	2.276461804	2.471291711	-3
Caquetá	10	4988	60	9343.11	1	3.697926445	1.77815125	3.970491462
Cauca	91	2705	717	12595.44	1.959041392	3.432167269	2.855519156	4.100213343
Cesar	95	0.001	133	26.4	1.977723605	-3	2.123851641	1.421603927
Chocó	16	1025	19	1802.84	1.204119983	3.010723865	1.278753601	3.255957185
Córdoba	170	3136	258	2668.29	2.230448921	3.496376054	2.411619706	3.426233029
Guaviare	1	8658	0.1	6837.99	0	3.937417581	-1	3.834928461
Huila	162	0.001	333	0.001	2.209515015	-3	2.522444234	-3
Magdalena	183	213	193	34.93	2.26245109	2.328379603	2.285557309	1.543198586
Nariño	214	13875	340	42627.38	2.330413773	4.142232992	2.531478917	4.62968864
Norte Santander	120	844	470	24830.61	2.079181246	2.926342447	2.672097858	4.394987389
Putumayo	1	8963	0.1	25162.41	0	3.952453396	-1	4.400752235
Quindío	107	0.001	289	0.001	2.029383778	-3	2.460897843	-3
Risaralda	340	0.001	501	0.001	2.531478917	-3	2.699837726	-3
Sucre	42	0.001	126	0.001	1.62324929	-3	2.100370545	-3
Correlation		-0.147887772		0.179073946		-0.419714241		-0.355779241

Comerce	2005	2005	2016	2016	Log 2005	Log 2005	Log 2016	Log 2016
	GDP	**Coca hectares**	**GDP**	**Coca ha**	**COP**	**Coca ha**	**COP**	**Coca ha**
Amazonas	46	897	76	166.77	1.662757832	2.952792443	1.880813592	2.222117929
Caldas	550	189	817	0.001	2.740362689	2.276461804	2.912222057	-3
Caquetá	177	4988	273	9343.11	2.247973266	3.697926445	2.436162647	3.970491462
Cauca	433	2705	681	12595.44	2.636487896	3.432167269	2.833147112	4.100213343
Cesar	498	0.001	839	26.4	2.697229343	-3	2.923761961	1.421603927
Chocó	112	1025	197	1802.84	2.049218023	3.010723865	2.294466226	3.255957185
Córdoba	773	3136	1173	2668.29	2.888179494	3.496376054	3.069298012	3.426233029
Guaviare	42	8658	84	6837.99	1.62324929	3.937417581	1.924279286	3.834928461
Huila	550	0.001	1006	0.001	2.740362689	-3	3.002597981	-3
Magdalena	739	213	1099	34.93	2.868644438	2.328379603	3.040997692	1.543198586
Nariño	1045	13875	1565	42627.38	3.01911629	4.142232992	3.194514342	4.62968864
Norte Santander	740	844	1079	24830.61	2.86923172	2.926342447	3.033021445	4.394987389
Putumayo	97	8963	178	25162.41	1.986771734	3.952453396	2.250420002	4.400752235
Quindío	439	0.001	655	0.001	2.64246452	-3	2.8162413	-3
Risaralda	613	0.001	974	0.001	2.787460475	-3	2.988558957	-3
Sucre	412	0.001	663	0.001	2.614897216	-3	2.821513528	-3
Correlation		0.031832817		0.283098684		-0.334177266		-0.307028543

Comerce (only resale activities)	2005	2005	2016	2016	Log 2005	Log 2005	Log 2016	Log 2016
	GDP	**Coca hectares**	**GDP**	**Coca ha**	**COP**	**Coca ha**	**COP**	**Coca ha**
Amazonas	32	897	52	166.77	1.505149978	2.952792443	1.716003344	2.222117929
Caldas	282	189	383	0.001	2.450249108	2.276461804	2.583198774	-3
Caquetá	87	4988	113	9343.11	1.939519253	3.697926445	2.053078443	3.970491462
Cauca	154	2705	211	12595.44	2.187520721	3.432167269	2.324282455	4.100213343
Cesar	301	0.001	505	26.4	2.478566496	-3	2.703291378	1.421603927
Chocó	25	1025	52	1802.84	1.397940009	3.010723865	1.716003344	3.255957185
Córdoba	470	3136	610	2668.29	2.672097858	3.496376054	2.785329835	3.426233029
Guaviare	22	8658	47	6837.99	1.342422681	3.937417581	1.672097858	3.834928461
Huila	303	0.001	565	0.001	2.481442629	-3	2.752048448	-3
Magdalena	408	213	558	34.93	2.610660163	2.328379603	2.746634199	1.543198586
Nariño	687	13875	928	42627.38	2.836956737	4.142232992	2.967547976	4.62968864
Norte Santander	446	844	586	24830.61	2.649334859	2.926342447	2.767897616	4.394987389
Putumayo	34	8963	72	25162.41	1.531478917	3.952453396	1.857332496	4.400752235
Quindío	265	0.001	367	0.001	2.423245874	-3	2.564666064	-3
Risaralda	307	0.001	476	0.001	2.487138375	-3	2.677606953	-3
Sucre	248	0.001	380	0.001	2.394451681	-3	2.579783597	-3
Correlation		0.112539801		0.310591392		-0.366264782		-0.356792453

Services	2005	2005	2016	2016	Log 2005	Log 2005	Log 2016	Log 2016
	GDP	**Coca hectares**	**GDP**	**Coca ha**	**COP**	**Coca ha**	**COP**	**Coca ha**
Amazonas	14	897	31	166.77	1.146128036	2.952792443	1.491361694	2.222117929
Caldas	1035	189	1331	0.001	3.01494035	2.276461804	3.124178055	-3
Caquetá	148	4988	201	9343.11	2.170261715	3.697926445	2.303196057	3.970491462
Cauca	760	2705	1328	12595.44	2.880813592	3.432167269	3.123198075	4.100213343
Cesar	408	0.001	758	26.4	2.610660163	-3	2.879669206	1.421603927
Chocó	51	1025	87	1802.84	1.707570176	3.010723865	1.939519253	3.255957185
Córdoba	891	3136	1440	2668.29	2.949877704	3.496376054	3.158362492	3.426233029
Guaviare	15	8658	23	6837.99	1.176091259	3.937417581	1.361727836	3.834928461
Huila	514	0.001	872	0.001	2.710963119	-3	2.940516485	-3
Magdalena	472	213	790	34.93	2.673941999	2.328379603	2.897627091	1.543198586
Nariño	561	13875	911	42627.38	2.748962861	4.142232992	2.959518377	4.62968864
Norte Santander	854	844	1398	24830.61	2.931457871	2.926342447	3.145507171	4.394987389
Putumayo	62	8963	114	25162.41	1.792391689	3.952453396	2.056904851	4.400752235
Quindío	325	0.001	560	0.001	2.511883361	-3	2.748188027	-3
Risaralda	963	0.001	1538	0.001	2.983626287	-3	3.186956335	-3
Sucre	208	0.001	368	0.001	2.318063335	-3	2.565847819	-3
Correlation		-0.246718561		0.063389521		-0.298690486		-0.311044311

Real state Services	2005	2005	2016	2016	Log 2005	Log 2005	Log 2016	Log 2016
	GDP	Coca hectares	GDP	Coca ha	COP	Coca ha	COP	Coca ha
Amazonas	5	897	8	166.77	0.698970004	2.952792443	0.903089987	2.222117929
Caldas	274	189	372	0.001	2.437750563	2.276461804	2.57054294	-3
Caquetá	48	4988	70	9343.11	1.681241237	3.697926445	1.84509804	3.970491462
Cauca	141	2705	197	12595.44	2.149219113	3.432167269	2.294466226	4.100213343
Cesar	138	0.001	199	26.4	2.139879086	-3	2.298853076	1.421603927
Chocó	29	1025	40	1802.84	1.462397998	3.010723865	1.602059991	3.255957185
Córdoba	190	3136	264	2668.29	2.278753601	3.496376054	2.421603927	3.426233029
Guaviare	5	8658	6	6837.99	0.698970004	3.937417581	0.77815125	3.834928461
Huila	187	0.001	266	0.001	2.271841607	-3	2.424881637	-3
Magdalena	203	213	275	34.93	2.307496038	2.328379603	2.439332694	1.543198586
Nariño	256	13875	347	42627.38	2.408239965	4.142232992	2.540329475	4.62968864
Norte Santander	507	844	721	24830.61	2.705007959	2.926342447	2.857935265	4.394987389
Putumayo	24	8963	34	25162.41	1.380211242	3.952453396	1.531478917	4.400752235
Quindío	143	0.001	199	0.001	2.155336037	-3	2.298853076	-3
Risaralda	330	0.001	463	0.001	2.51851394	-3	2.665580991	-3
Sucre	92	0.001	126	0.001	1.963787827	-3	2.100370545	-3
Correlation		-0.202491795		0.25667657		-0.337765495		-0.322885098

Comerce (only resale activities)	2005	2005	2016	2016	Log 2005	Log 2005	Log 2016	Log 2016
	GDP	Coca hectares	GDP	Coca ha	COP	Coca ha	COP	Coca ha
Amazonas	32	897	52	166.77	1.505149978	2.952792443	1.716003344	2.222117929
Caldas	282	189	383	0.001	2.450249108	2.276461804	2.583198774	-3
Caquetá	87	4988	113	9343.11	1.939519253	3.697926445	2.053078443	3.970491462
Cauca	154	2705	211	12595.44	2.187520721	3.432167269	2.324282455	4.100213343
Cesar	301	0.001	505	26.4	2.478566496	-3	2.703291378	1.421603927
Chocó	25	1025	52	1802.84	1.397940009	3.010723865	1.716003344	3.255957185
Córdoba	470	3136	610	2668.29	2.672097858	3.496376054	2.785329835	3.426233029
Guaviare	22	8658	47	6837.99	1.342422681	3.937417581	1.672097858	3.834928461
Huila	303	0.001	565	0.001	2.481442629	-3	2.752048448	-3
Magdalena	408	213	558	34.93	2.610660163	2.328379603	2.746634199	1.543198586
Nariño	687	13875	928	42627.38	2.836956737	4.142232992	2.967547976	4.62968864
Norte Santander	446	844	586	24830.61	2.649334859	2.926342447	2.767897616	4.394987389
Putumayo	34	8963	72	25162.41	1.531478917	3.952453396	1.857332496	4.400752235
Quindío	265	0.001	367	0.001	2.423245874	-3	2.564666064	-3
Risaralda	307	0.001	476	0.001	2.487138375	-3	2.677606953	-3
Sucre	248	0.001	380	0.001	2.394451681	-3	2.579783597	-3
Correlation		0.112539801		0.310591392		-0.366264782		-0.356792453

Privat education expenses	2005	2005	2016	2016	Log 2005	Log 2005	Log 2016	Log 2016
	GDP	Coca hectares	GDP	Coca ha	COP	Coca ha	COP	Coca ha
Amazonas	1	897	1	166.77	0	2.952792443	0	2.222117929
Caldas	76	189	78	0.001	1.880813592	2.276461804	1.892094603	-3
Caquetá	9	4988	11	9343.11	0.954242509	3.697926445	1.041392685	3.970491462
Cauca	64	2705	93	12595.44	1.806179974	3.432167269	1.968482949	4.100213343
Cesar	65	0.001	90	26.4	1.812913357	-3	1.954242509	1.421603927
Chocó	4	1025	6	1802.84	0.602059991	3.010723865	0.77815125	3.255957185
Córdoba	59	3136	69	2668.29	1.770852012	3.496376054	1.838849091	3.426233029
Guaviare	0.1	8658	0.1	6837.99	-1	3.937417581	-1	3.834928461
Huila	55	0.001	91	0.001	1.740362689	-3	1.959041392	-3
Magdalena	77	213	102	34.93	1.886490725	2.328379603	2.008600172	1.543198586
Nariño	50	13875	72	42627.38	1.698970004	4.142232992	1.857332496	4.62968864
Norte Santander	93	844	127	24830.61	1.968482949	2.926342447	2.103803721	4.394987389
Putumayo	12	8963	9	25162.41	1.079181246	3.952453396	0.954242509	4.400752235
Quindío	38	0.001	53	0.001	1.579783597	-3	1.72427587	-3
Risaralda	68	0.001	76	0.001	1.832508913	-3	1.880813592	-3
Sucre	29	0.001	32	0.001	1.462397998	-3	1.505149978	-3
Correlation		-0.347217618		0.096344624		-0.3596335		-0.311583612

Unemployment Rate	Unemployment Rate % 2005	Coca ha 2005	Unemployment Rate % Log 2016	Coca ha Log 2016	Unemployment Rate % Log 2005	Coca ha Log 2005	Unemployment Rate % Log 2016	Coca ha Log 2016
Caldas	14	189	9.28	0.001	1.146128036	2.276461804	0.967547976	-3
Caquetá	10.27	4988	8.2	9343.11	1.011570444	3.697926445	0.913813852	3.970491462
Cauca	9.66	2705	7.91	12595.44	0.984977126	3.432167269	0.898176483	4.100213343
Cesar	6.69	0.001	11.46	26.4	0.825426118	-3	1.059184618	1.421603927
Chocó	10.49	1025	10.68	1802.84	1.020775488	3.010723865	1.028571253	3.255957185
Córdoba	12.29	3136	9.75	2668.29	1.089551883	3.496376054	0.989004616	3.426233029
Huila	11.79	0.001	8.01	0.001	1.071513805	-3	0.903632516	-3
Magdalena	6.44	213	8.43	34.93	0.808885867	2.328379603	0.925827575	1.543198586
Nariño	11.61	13875	7.6	42627.38	1.06483222	4.142232992	0.880813592	4.62968864
Norte Santander	13.19	844	12.6	24830.61	1.120244796	2.926342447	1.100370545	4.394987389
Quindío	19.53	0.001	13.93	0.001	1.290702243	-3	1.143951116	-3
Risaralda	14.28	0.001	9.25	0.001	1.154728207	-3	0.966141733	-3
Sucre	5.99	0.001	9.38	0.001	0.777426822	-3	0.972202838	-3
Correlation		-0.003104683		-0.182189897		0.039597525		-0.145980063

Appendix C: Correlation Analysis Estimated Coca Income

Agriculture	2005	2005	2016	2016	Log 2005	Log 2005	Log 2016	Log 2016
	GDP	**Estimated Income**	**GDP**	**Estimated Income**	**GDP**	**Estimated Income**	**GDP**	**Estimated Income**
Amazonas	42	13	32	2	1.62324929	1.108005257	1.505149978	0.19734444
Caldas	712	2	949	1	2.852479994	0.346244423	2.977266212	0
Caquetá	291	71	343	88	2.463892989	1.853139259	2.53529412	1.945717973
Cauca	748	18	922	180	2.873901598	1.254165404	2.964730921	2.255426157
Cesar	886	1	865	0	2.947433722	0	2.937016107	-0.438977526
Chocó	316	7	329	26	2.499687083	0.832722	2.517195898	1.411169999
Córdoba	1159	53	1458	29	3.064083436	1.722944777	3.163757524	1.466726271
Guaviare	34	219	2	77	1.531478917	2.340077563	0.301029996	1.885405925
Huila	1014	1	1393	1	3.006037955	0	3.143951116	0
Magdalena	924	4	987	1	2.965671971	0.554948326	2.994317153	0
Nariño	941	92	1146	609	2.973589623	1.964231127	3.059184618	2.784901454
Norte Santander	746	10	815	342	2.872738827	0.996125065	2.911157609	2.534405936
Putumayo	99	128	88	238	1.995635195	2.10766621	1.944482672	2.375978746
Quindío	453	1	566	1	2.656098202	0	2.752816431	0
Risaralda	587	1	725	1	2.768638101	0	2.860338007	0
Sucre	423	1	527	1	2.626340367	0	2.721810615	0
Correlation		-0.429942815		0.11929478		-0.46		-0.19

Cultivation of agriculture products	2005	2005	2016	2016	Log 2005	Log 2005	Log 2016	Log 2016
	GDP	**Estimated Income**	**GDP**	**Estimated Income**	**GDP**	**Estimated Income**	**GDP**	**Estimated Income**
Amazonas	3	13	0.1	2	0.477121255	1.108005257	-1	0.19734444
Caldas	140	2	309	1	2.146128036	0.346244423	2.489958479	0
Caquetá	66	71	62	88	1.819543936	1.853139259	1.792391689	1.945717973
Cauca	282	18	241	180	2.450249108	1.254165404	2.382017043	2.255426157
Cesar	349	1	344	0	2.542825427	0	2.536558443	-0.438977526
Chocó	101	7	88	26	2.004321374	0.832722	1.944482672	1.411169999
Córdoba	462	53	735	29	2.664641976	1.722944777	2.866287339	1.466726271
Guaviare	26	219	1	77	1.414973348	2.340077563	0	1.885405925
Huila	405	1	372	1	2.607455023	0	2.57054294	0
Magdalena	391	4	440	0	2.592176757	0.554948326	2.643452676	-0.317382868
Nariño	453	92	511	609	2.656098202	1.964231127	2.7084209	2.784901454
Norte Santander	483	10	501	342	2.683947131	0.996125065	2.699837726	2.534405936
Putumayo	65	128	39	238	1.812913357	2.10766621	1.591064607	2.375978746
Quindío	133	1	213	1	2.123851641	0	2.328379603	0
Risaralda	133	1	167	1	2.123851641	0	2.222716471	0
Sucre	153	1	188	1	2.184691431	0	2.274157849	0
Correlation		-0.273529777		0.27138626		-0.26		-0.02

Livestock production	2005	2005	2016	2016	Log 2005	Log 2005	Log 2016	Log 2016
	GDP	**Estimated Income**	**GDP**	**Estimated Income**	**GDP**	**Estimated Income**	**GDP**	**Estimated Income**
Amazonas	1	13	2	2	0	1.108005257	0.301029996	0.19734444
Caldas	166	2	197	1	2.220108088	0.346244423	2.294466226	0
Caquetá	193	71	239	88	2.285557309	1.853139259	2.378397901	1.945717973
Cauca	157	18	192	180	2.195899652	1.254165404	2.283301229	2.255426157
Cesar	487	1	413	1	2.687528961	0	2.615950052	0
Chocó	72	7	64	26	1.857332496	0.832722	1.806179974	1.411169999
Córdoba	658	53	643	29	2.818225894	1.722944777	2.808210973	1.466726271
Guaviare	5	219	5	77	0.698970004	2.340077563	0.698970004	1.885405925
Huila	170	1	167	1	2.230448921	0	2.222716471	0
Magdalena	471	4	429	0	2.673020907	0.554948326	2.632457292	-0.317382868
Nariño	247	92	301	609	2.392696953	1.964231127	2.478566496	2.784901454
Norte Santander	182	10	210	342	2.260071388	0.996125065	2.322219295	2.534405936
Putumayo	19	128	31	238	1.278753601	2.10766621	1.491361694	2.375978746
Quindío	147	1	223	1	2.167317335	0	2.348304863	0
Risaralda	189	1	253	1	2.276461804	0	2.403120521	0
Sucre	243	1	298	1	2.385606274	0	2.474216264	0
Correlation		-0.290216113		-0.058304522		-0.38		-0.11

Manufacture Industry	2005 GDP	2005 Estimated Income	2016 GDP	2016 Estimated Income	Log 2005 GDP	Log 2005 Estimated Income	Log 2016 GDP	Log 2016 Estimated Income
Amazonas	5	13	6	2	0.698970004	1.108005257	0.77815125	0.19734444
Caldas	999	2	1052	1	2.999565488	0.346244423	3.02201574	0
Caquetá	65	71	72	88	1.812913357	1.853139259	1.857332496	1.945717973
Cauca	834	18	1489	180	2.921166051	1.254165404	3.172894698	2.255426157
Cesar	261	1	364	0	2.416640507	0	2.561101384	-0.438977526
Chocó	21	7	27	26	1.322219295	0.832722	1.431363764	1.411169999
Córdoba	272	53	283	29	2.434568904	1.722944777	2.451786436	1.466726271
Guaviare	8	219	11	77	0.903089987	2.340077563	1.041392685	1.885405925
Huila	304	1	356	1	2.482873584	0	2.551449998	0
Magdalena	291	4	391	1	2.463892989	0.554948326	2.592176757	0
Nariño	335	92	403	609	2.525044807	1.964231127	2.605305046	2.784901454
Norte Santander	423	10	579	342	2.626340367	0.996125065	2.762678564	2.534405936
Putumayo	24	128	11	238	1.380211242	2.10766621	1.041392685	2.375978746
Quindío	204	1	263	1	2.309630167	0	2.419955748	0
Risaralda	793	1	1128	1	2.899273187	0	3.0523091	0
Sucre	235	1	288	1	2.371067862	0	2.459392488	0
Correlation		-0.413206263		0.056079956		-0.49		-0.20

Food, beverages and tobacco production	2005 GDP	2005 Estimated Income	2016 GDP	2016 Estimated Income	Log 2005 GDP	Log 2005 Estimated Income	Log 2016 GDP	Log 2016 Estimated Income
Amazonas	2	13	3	166.77	0.301029996	1.108005257	0.477121255	2.222117929
Caldas	357	2	410	2	2.552668216	0.346244423	2.612783857	0.19734444
Caquetá	42	71	47	1	1.62324929	1.853139259	1.672097858	0
Cauca	288	18	404	88	2.459392488	1.254165404	2.606381365	1.945717973
Cesar	152	1	234	180	2.181843588	0	2.369215857	2.255426157
Chocó	5	7	11	0	0.698970004	0.832722	1.041392685	-0.438977526
Córdoba	158	53	135	26	2.198657087	1.722944777	2.130333768	1.411169999
Guaviare	3	219	6	29	0.477121255	2.340077563	0.77815125	1.466726271
Huila	146	1	150	77	2.164352856	0	2.176091259	1.885405925
Magdalena	204	4	249	1	2.309630167	0.554948326	2.396199347	0
Nariño	113	92	105	0	2.053078443	1.964231127	2.021189299	-0.317382868
Norte Santander	98	10	104	609	1.991226076	0.996125065	2.017033339	2.784901454
Putumayo	7	128	6	342	0.84509804	2.10766621	0.77815125	2.534405936
Quindío	94	1	90	238	1.973127854	0	1.954242509	2.375978746
Risaralda	257	1	333	1	2.409933123	0	2.522444234	0
Sucre	57	1	61	1	1.755874856	0	1.785329835	0
				1				
Correlation		-0.448985796		-0.218571558		-0.474191329		-0.180922849

Construction (buildings and residences)	2005 GDP	2005 Estimated Income	2016 GDP	2016 Estimated Income	Log 2005 GDP	Log 2005 Estimated Income	Log 2016 GDP	Log 2016 Estimated Income
Amazonas	0.1	13	0.1	2	-1	1.108005257	-1	0.19734444
Caldas	170	2	296	1	2.230448921	0.346244423	2.471291711	0
Caquetá	10	71	60	88	1	1.853139259	1.77815125	1.945717973
Cauca	91	18	717	180	1.959041392	1.254165404	2.855519156	2.255426157
Cesar	95	1	133	0	1.977723605	0	2.123851641	-0.438977526
Chocó	16	7	19	26	1.204119983	0.832722	1.278753601	1.411169999
Córdoba	170	53	258	29	2.230448921	1.722944777	2.411619706	1.466726271
Guaviare	0.1	219	0.1	77	-1	2.340077563	-1	1.885405925
Huila	162	1	333	1	2.209515015	0	2.522444234	0
Magdalena	183	4	193	1	2.26245109	0.554948326	2.285557309	0
Nariño	214	92	340	609	2.330413773	1.964231127	2.531478917	2.784901454
Norte Santander	120	10	470	342	2.079181246	0.996125065	2.672097858	2.534405936
Putumayo	0.1	128	0.1	238	-1	2.10766621	-1	2.375978746
Quindío	107	1	289	1	2.029383778	0	2.460897843	0
Risaralda	340	1	501	1	2.531478917	0	2.699837726	0
Sucre	42	1	126	1	1.62324929	0	2.100370545	0
Correlation		-0.36617256		0.26211516		-0.56297706		-0.176402341

Comerce	2005	2005	2016	2016	Log 2005	Log 2005	Log 2016	Log 2016
	GDP	**Estimated Income**	**GDP**	**Estimated Income**	**GDP**	**Estimated Income**	**GDP**	**Estimated Income**
Amazonas	46	13	76	2	1.662757832	1.108005257	1.880813592	0.19734444
Caldas	550	2	817	1	2.740362689	0.346244423	2.912222057	0
Caquetá	177	71	273	88	2.247973266	1.853139259	2.436162647	1.945717973
Cauca	433	18	681	180	2.636487896	1.254165404	2.833147112	2.255426157
Cesar	498	1	839	0	2.697229343	0	2.923761961	-0.438977526
Chocó	112	7	197	26	2.049218023	0.832722	2.294466226	1.411169999
Córdoba	773	53	1173	29	2.888179494	1.722944777	3.069298012	1.466726271
Guaviare	42	219	84	77	1.62324929	2.340077563	1.924279286	1.885405925
Huila	550	1	1006	1	2.740362689	0	3.002597981	0
Magdalena	739	4	1099	1	2.868644438	0.554948326	3.040997692	0
Nariño	1045	92	1565	609	3.01911629	1.964231127	3.194514342	2.784901454
Norte Santander	740	10	1079	342	2.86923172	0.996125065	3.033021445	2.534405936
Putumayo	97	128	178	238	1.986771734	2.10766621	2.250420002	2.375978746
Quindío	439	1	655	1	2.64246452	0	2.8162413	0
Risaralda	613	1	974	1	2.787460475	0	2.988558957	0
Sucre	412	1	663	1	2.614897216	0	2.821513528	0
Correlation		-0.320643823		0.379583199		-0.431663673		-0.14432605

Comerce (only resale activities)	2005	2005	2016	2016	Log 2005	Log 2005	Log 2016	Log 2016
	COP	Coca ha	COP	Coca ha	COP	Coca ha	COP	Coca ha
Amazonas	32	13	52	2	1.505149978	1.108005257	1.716003344	0.19734444
Caldas	282	2	383	1	2.450249108	0.346244423	2.583198774	0
Caquetá	87	71	113	88	1.939519253	1.853139259	2.053078443	1.945717973
Cauca	154	18	211	180	2.187520721	1.254165404	2.324282455	2.255426157
Cesar	301	1	505	0	2.478566496	0	2.703291378	-0.438977526
Chocó	25	7	52	26	1.397940009	0.832722	1.716003344	1.411169999
Córdoba	470	53	610	29	2.672097858	1.722944777	2.785329835	1.466726271
Guaviare	22	219	47	77	1.342422681	2.340077563	1.672097858	1.885405925
Huila	303	1	565	1	2.481442629	0	2.752048448	0
Magdalena	408	4	558	1	2.610660163	0.554948326	2.746634199	0
Nariño	687	92	928	609	2.836956737	1.964231127	2.967547976	2.784901454
Norte Santander	446	10	586	342	2.649334859	0.996125065	2.767897616	2.534405936
Putumayo	34	128	72	238	1.531478917	2.10766621	1.857332496	2.375978746
Quindío	265	1	367	1	2.423245874	0	2.564666064	0
Risaralda	307	1	476	1	2.487138375	0	2.677606953	0
Sucre	248	1	380	1	2.394451681	0	2.579783597	0
Correlation		-0.245740993		0.405226999		-0.42		-0.22

Services	2005	2005	2016	2016	Log 2005	Log 2005	Log 2016	Log 2016
	GDP	**Estimated Income**	**GDP**	**Estimated Income**	**GDP**	**Estimated Income**	**GDP**	**Estimated Income**
Amazonas	14	13	31	2	1.146128036	1.108005257	1.491361694	0.19734444
Caldas	1035	2	1331	1	3.01494035	0.346244423	3.124178055	0
Caquetá	148	71	201	88	2.170261715	1.853139259	2.303196057	1.945717973
Cauca	760	18	1328	180	2.880813592	1.254165404	3.123198075	2.255426157
Cesar	408	1	758	0	2.610660163	0	2.879669206	-0.438977526
Chocó	51	7	87	26	1.707570176	0.832722	1.939519253	1.411169999
Córdoba	891	53	1440	29	2.949877704	1.722944777	3.158362492	1.466726271
Guaviare	15	219	23	77	1.176091259	2.340077563	1.361727836	1.885405925
Huila	514	1	872	1	2.710963119	0	2.940516485	0
Magdalena	472	4	790	1	2.673941999	0.554948326	2.897627091	0
Nariño	561	92	911	609	2.748962861	1.964231127	2.959518377	2.784901454
Norte Santander	854	10	1398	342	2.931457871	0.996125065	3.145507171	2.534405936
Putumayo	62	128	114	238	1.792391689	2.10766621	2.056904851	2.375978746
Quindío	325	1	560	1	2.511883361	0	2.748188027	0
Risaralda	963	1	1538	1	2.983626287	0	3.186956335	0
Sucre	208	1	368	1	2.318063335	0	2.565847819	0
Correlation		-0.400945678		0.139178189		-0.417922766		-0.132430417

Real state Services	2005 GDP	2005 Estimated Income	2016 GDP	2016 Estimated Income	Log 2005 GDP	Log 2005 Estimated Income	Log 2016 GDP	Log 2016 Estimated Income
Amazonas	5	13	8	2	0.698970004	1.108005257	0.903089987	0.19734444
Caldas	274	2	372	1	2.437750563	0.346244423	2.57054294	0
Caquetá	48	71	70	88	1.681241237	1.853139259	1.84509804	1.945717973
Cauca	141	18	197	180	2.149219113	1.254165404	2.294466226	2.255426157
Cesar	138	1	199	1	2.139879086	0	2.298853076	0
Chocó	29	7	40	26	1.462397998	0.832722	1.602059991	1.411169999
Córdoba	190	53	264	29	2.278753601	1.722944777	2.421603927	1.466726271
Guaviare	5	219	6	77	0.698970004	2.340077563	0.77815125	1.885405925
Huila	187	1	266	1	2.271841607	0	2.424881637	0
Magdalena	203	4	275	1	2.307496038	0.554948326	2.439332694	0
Nariño	256	92	347	609	2.408239965	1.964231127	2.540329475	2.784901454
Norte Santander	507	10	721	342	2.705007959	0.996125065	2.857935265	2.534405936
Putumayo	24	128	34	238	1.380211242	2.10766621	1.531478917	2.375978746
Quindío	143	1	199	1	2.155336037	0	2.298853076	0
Risaralda	330	1	463	1	2.51851394	0	2.665580991	0
Sucre	92	1	126	1	1.963787827	0	2.100370545	0
Correlation		-0.386618762		0.330618126		-0.467515627		-0.116868471

Privat education expenses	2005 GDP	2005 Estimated Income	2016 GDP	2016 Estimated Income	Log 2005 GDP	Log 2005 Estimated Income	Log 2016 GDP	Log 2016 Estimated Income
Amazonas	1	13	1	2	0	1.108005257	0	0.19734444
Caldas	76	2	78	1	1.880813592	0.346244423	1.892094603	0
Caquetá	9	71	11	88	0.954242509	1.853139259	1.041392685	1.945717973
Cauca	64	18	93	180	1.806179974	1.254165404	1.968482949	2.255426157
Cesar	65	1	90	1	1.812913357	0	1.954242509	0
Chocó	4	7	6	26	0.602059991	0.832722	0.77815125	1.411169999
Córdoba	59	53	69	29	1.770852012	1.722944777	1.838849091	1.466726271
Guaviare	0.1	219	0.1	77	-1	2.340077563	-1	1.885405925
Huila	55	1	91	1	1.740362689	0	1.959041392	0
Magdalena	77	4	102	1	1.886490725	0.554948326	2.008600172	0
Nariño	50	92	72	609	1.698970004	1.964231127	1.857332496	2.784901454
Norte Santander	93	10	127	342	1.968482949	0.996125065	2.103803721	2.534405936
Putumayo	12	128	9	238	1.079181246	2.10766621	0.954242509	2.375978746
Quindío	38	1	53	1	1.579783597	0	1.72427587	0
Risaralda	68	1	76	1	1.832508913	0	1.880813592	0
Sucre	29	1	32	1	1.462397998	0	1.505149978	0
Correlation		-0.50752922		0.18027346		-0.506563066		-0.174164437

Unemployment Rate	Unemployment Rate % 2005	Estimated Income 2005	Unemployment Rate % Log 2016	Estimamted Income Log 2016	Unemployment Rate % Log 2005	Estimated Income Log 2005	Unemployment Rate % Log 2016	Estimamted Income Log 2016
Caldas	14	2	9.28	1	1.146128036	0.346244423	0.967547976	0
Caquetá	10.27	71	8.2	88	1.011570444	1.853139259	0.913813852	1.945717973
Cauca	9.66	18	7.91	180	0.984977126	1.254165404	0.898176483	2.255426157
Cesar	6.69	1	11.46	0	0.825426118	0	1.059184618	-0.438977526
Chocó	10.49	7	10.68	26	1.020775488	0.832722	1.028571253	1.411169999
Córdoba	12.29	53	9.75	29	1.089551883	1.722944777	0.989004616	1.466726271
Huila	11.79	1	8.01	1	1.071513805	0	0.903632516	0
Magdalena	6.44	4	8.43	0	0.808885867	0.554948326	0.925827575	-0.317382868
Nariño	11.61	92	7.6	609	1.06483222	1.964231127	0.880813592	2.784901454
Norte Santander	13.19	10	12.6	342	1.120244796	0.996125065	1.100370545	2.534405936
Quindío	19.53	1	13.93	1	1.290702243	0	1.143951116	0
Risaralda	14.28	1	9.25	1	1.154728207	0	0.966141733	0
Sucre	5.99	1	9.38	1	0.777426822	0	0.972202838	0
Correlation		-0.003598811		-0.175818616		0.071005303		-0.195447719